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FRYER (J. C. F.) & others. **Wireworms and Food Production. A Wireworm Survey of England and Wales, 1939–42.**—*Bull. Minist. Agric.* no. 128, [2]+62 pp., 7 figs., 1 fldg. map., 24 refs. London, 1944.

The following is based on the authors' summary. Early in 1939, an investigation was begun in England and Wales of the problem of wireworms in relation to the cropping of newly ploughed grassland. A rapid method of estimating wireworm populations was developed, and about 336,500 acres had been sampled up to October 1942. The estimates were based on the numbers of wireworms 5 mm. or more in length in soil samples from individual fields ; the probable limits of error of the method were determined, and the degree of accuracy proved adequate for the purposes in view.

The survey showed that wireworms occur in almost all the agricultural land of England and Wales. Species of *Agriotes* are the most numerous. *A. obscurus*, L., is the dominant species in northern England and the north and middle of Wales, and comprised about 90 per cent. of the adults that occurred in samples taken in the autumn, winter and early spring. This species, *A. lineatus*, L., and *A. sputator*, L., are more equal in abundance in the Midlands and South Wales, and *A. lineatus* and *A. sputator* are locally dominant and *A. obscurus* is often least numerous in eastern and southern England. Though wireworms of other genera, a list of which is given, sometimes occur and are able to cause injury to farm crops, they exceed 10 per cent. of the population only occasionally on poor upland or on land carrying a moorland or heath vegetation. On the average, populations in grassland are higher in the south and east of the country than elsewhere. In the southern half, wireworms are numerous in both light and heavy soils, but heavy land usually carries higher populations than light land in the neighbourhood. This association is less marked in northern England and in parts of Wales, where high populations are much less common in both light and heavy land. The greater moisture content of heavy soils in summer possibly predisposes such land to infestation in areas where rainfall is low. There is little evidence that fields regularly mown for hay differ in infestation from land more or less permanently grazed, but land in a high state of fertility and under good management may carry a high population. A reliable estimate of the wireworm population of a field cannot be made from knowledge of its agricultural history, soil and herbage, but when this knowledge is supported by the results of sampling in the neighbourhood, a fairly accurate forecast is sometimes possible. Of all the grass fields examined, about 50 per cent. have had low populations (not more than 300,000 per acre), about 33 per cent. medium populations (325,000–600,000), 12 per cent. high populations (625,000–1,000,000) and 5 per cent. very high populations (exceeding one million per acre). From data so far available, it seems that the wireworm population is fairly stable in grassland of 15 or more years' standing and still increasing in grassland less than 15 years old.

The crop history of sampled fields has provided information that has been of value in making recommendations for the cropping of newly-broken grassland, which has most frequently been assigned to cereals. A fairly definite association was found between the wireworm population and the final plant density and yield of both wheat and oats, the rate of loss of plants increasing as the wireworm population rose, lower yields being associated with high populations, and partial or complete failure of the crop occurring with greatest frequency in fields with very high populations. With barley, there is less marked association between final plant density and wireworm population, and crop success seems almost independent of the level of infestation. It is concluded, therefore, that where a high wireworm population is the only adverse factor, barley is more likely to succeed than either wheat or oats [*cf. R.A.E.*, A **31** 426]. In the presence of high populations, mixtures of oats and barley are usually more successful than oats alone. Flax grown for fibre or linseed consistently succeeds on heavily infested

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land [*loc. cit.*]. Peas and beans may suffer some loss, but the yield seems independent of the level of wireworm population, and these crops are therefore considered resistant [*cf.* **30** 455]. Mixtures of cereals with pulses also show little association between yield and population, and their success, like that of mixed cereals, is probably associated with the inclusion of a resistant component. With root crops, attack before singling seldom affects the final stand of plants, but subsequent attack may cause severe thinning. In spite of this, root crops possess high compensating power, and a well distributed loss of 25 per cent. of the plants may occur without appreciable effect on the yield. Wireworms seldom affect the establishment of potatoes, though some infestation of the seed tubers and stem bases may occur in dry soils. Attack on the new tubers may seriously impair the quality of the crop and reduce the yield. Intensity of attack in the lighter soils is associated with the level of wireworm population, and injury increases steadily with the period of exposure to attack [*cf.* **31** 426] ; in medium and heavy soils, potatoes may escape attack even in the presence of high populations. Ley, produced by direct reseeding or by sowing under a nurse crop, runs some risk of attack. Grass seedlings are injured in the same way as seedling cereals, but clovers are resistant and often become established in spite of high wireworm populations.

Soil conditions, by influencing soil moisture and consolidation, freedom of movement of wireworms and the early establishment of seedlings, affect the intensity and duration of attack. Crops seem to tolerate high population better on heavier than on lighter soils in the same district. Yields are often satisfactory despite high wireworm populations in soils of high fertility, but failures occur in fields of poor fertility, even though populations are low. Efficient ploughing and cultivation stimulate germination and the early establishment of seedlings. The interval between ploughing and seeding is less important than sowing in a satisfactory bed under good weather conditions. The rates of seeding in general use are normally sufficient, but where there is risk of wireworm attack, an increase of half a bushel or more per acre in the seed rate of cereals has proved justifiable. In soil that is seriously deficient in potash, phosphate or other minerals, or in which there is excessive acidity, recovery from wireworm attack is seldom complete, and even low populations may be associated with crop failure.

When grassland is broken up for arable cropping, the wireworm population decreases fairly rapidly, and the rate of decrease is maintained or accelerated with each succeeding year of cultivation. In a field having an initial population of 500,000 per acre, about 25 per cent. reduction may be expected by the end of the first year after ploughing and over 50 per cent. by the end of the second. When grassland is kept under arable cultivation for some years, the population decreases until it finally becomes fairly stable at a low level ; in observed cases this has usually been below 225,000 per acre and should be well within the limits of safety for most farm crops, provided that the standard of farming is reasonably good. Under ley, the reverse takes place, and with the increasing stability of the soil and vegetation conditions as the ley is prolonged, the population increases, the rate of increase apparently depending on the initial population and local conditions of soil, climate, herbage and management.

TRAILL (D.), MCLEAN (A.) & BOVINGDON (H. H. S.). **The Mothproofing of Furs.** —*Chem. & Industr.* 1944 no. 32 pp. 284–286, 4 refs. London, 1944.

It was discovered accidentally that treatment of fibres of animal origin with a saturated solution of salt (sodium chloride) containing small concentrations of formaldehyde and hydrochloric acid rendered them highly resistant to clothes moths. The adoption of such a process in the wool trade is unlikely, but since it appeared promising as a treatment for furs, experiments were carried out on it in England. The test insect chosen was *Tineola biselliella*,

Humm., which is responsible for most of the insect damage to animal fibres. Fleshed rabbit skins were steeped for 2 days in saturated solutions of salt containing about 1 per cent. formaldehyde and hydrochloric acid or sodium hydroxide to give three different pH values at a temperature of 35°C. [95°F.]. They were then freed from the liquor as thoroughly as possible, painted on the flesh side with a mineral-oil fat-liquoring agent and dried at ordinary temperatures ; salt was removed from the fur by gentle brushing. The treatments were tested by cutting two-inch squares from the skins and putting them in glass dishes with 15 small larvae ; fresh larvae were added 18 days later. The average percentages of fur damaged after 32 days' exposure were estimated to be 16·7, 69·9 and 82·7 after treatment with solutions with pH values of less than 2, 5·5 and 9·5, and 87·3 for the control treatment with saturated salt solution only (pH 6·7). The numbers of living small, half-grown and full-grown larvae present were 6, 0 and 0 after the first treatment, 0, 5 and 0 after the second, 1, 13 and 0 after the third, and 2, 14 and 22 on the control. No moths were produced after the first treatment, but a few emerged after the others. The best moth proofing thus resulted from treatment in the most acid medium, but pH is probably not the only factor involved, since the control and the solution of pH 9·5 gave similar results.

Since fur treated with a solution of salt, acid and formaldehyde of sufficiently low pH value proved toxic to the larvae, tests approximating more closely to natural conditions were carried out by exposing treated material to adult moths. Black woollen cloth was used, as it is difficult to count eggs on fur with accuracy. Part was soaked in the most acid solution (pH <2) and the remainder in a saturated solution of salt for 24 hours at 35°C., and then it was all washed thoroughly in cold water and dried. Ten strips (1×13 ins.) were cut from the cloth, loosely rolled and kept in pairs (one treated and one control) with 20 moths for ten days at 25°C. [77°F.], after which the eggs and small larvae were counted. There were 80 eggs and small larvae on the treated strips and 841 on the controls, indicating that the former were repellent to the ovipositing females.

A further series of experiments with rabbit skins showed that treatment for 2–3 days at 25°C. was about as effective as treatment for 2 days at 35°C., and in a final series, in which treated and untreated fur was dyed with a representative series of oxidation dyestuffs, applied by a number of methods commonly used in the fur trade, and exposed to *Tineola* larvae, as in the first test, for seven weeks at 27°C. [80·6°F.], it was shown that dyeing by these methods does not reduce the protection conferred against moths and that the moth-proofing treatment does not affect the shade obtained.

It is concluded that soaking in salt, formaldehyde and hydrochloric acid may be the basis of an effective and inexpensive moth-proofing treatment for furs, and would not involve the introduction of any new step into normal fur processing. Comparison of wools treated by this method and with a commercial moth-proofing agent of the type that can be used with acid-milling dyestuffs showed that the latter was somewhat the more toxic, but lacked all repellent effect, and that the total amount of protection obtained was practically the same for the two treatments.

HELY (P. C.). **The Bronze Orange Bug** (*Rhoecocoris sulciventris* Stål). **A Citrus Pest of the north Coast.**—*Agric. Gaz. N.S.W.* **55** pt. 9 pp. 397-401, 406, 4 figs., 5 refs. Sydney, 1944.

An account is given of the bionomics and control of *Rhoecocoris sulciventris*, Stål [*cf. R.A.E.*, A **23** 396 ; **26** 754], which is now a permanent pest in many *Citrus* orchards on the north coast of New South Wales and caused very severe damage in 1943. Natural control may be effected by very high temperatures, particularly when combined with low humidity, by birds and by predacious bugs, of which the Reduviid, *Pristhesancus papuensis*, Stål, is particularly

valuable, owing to the long life of the adults and the fact that they are active during the winter, feeding on the second-instar nymphs of *Rhoecocoris*. Parasitism of the eggs, probably by species of *Telenomus*, is of little importance, and low winter temperatures appear to have no effect.

Derris and cubé are effective in sprays against this Pentatomid [**26** 755] but have not recently been available, and the winter spray of resin and caustic soda recommended by Summerville [**19** 714] has not always been satisfactory. In experiments in November 1943, sprays of 2 and 4 per cent. creonaph, a recently developed combination of soft soap, naphthalene and a tar distillate [**32** 67], a spray of potassium cyanide in kerosene emulsion and a combination of 1 per cent. creonaph with 1 lb. potassium cyanide per 40 gals. all gave a good knock-down of bugs, but unless these were collected and destroyed, many of them recovered and returned to the trees. In laboratory tests with about 50 different materials, soft soap proved very effective in killing nymphs in the second instar when used at concentrations higher than 4 lb. per 40 gals., and gave complete mortality at 10 lb. per 40 gals. The addition of nicotine sulphate or cubé to the lower concentrations usually gave slightly increased kill, but was of little value at concentrations of 5 lb. per 40 gals.; superfine tobacco dust rendered the mixtures non-toxic. The most promising of the sprays tested in the laboratory were applied very thoroughly to a block of heavily infested Navel orange trees in June 1944. The average numbers of living bugs per 10 twigs on the trees after spraying and (in brackets) the mortality percentages in samples of bugs taken from the trees and from the ground, after the sprays had dried, and kept for ten days with foliage from the same trees, were 0·5 (98·3), 0·63 (97·1) and 0·13 (87·4) for sprays of 10, 7 and 5 lb. soft soap per 40 gals., 0·5 (96·05) and 0·5 (96.7) for sprays of 5 lb. soft soap per 40 gals. with ½ pint nicotine sulphate or 1 lb. cubé, 1·25 (99·6) for the resin-soda spray, 0·38 (100) for a spray of white oil and nicotine sulphate (8 : 1 : 640) and 10 (0) for no treatment.

It is concluded that the soft-soap spray has the advantages of high toxicity, low cost and ease of preparation, and that it leaves safe and temporary residues and can be applied after most commonly used sprays. It is not known whether it is effective against bugs at a later stage, though occasional third-instar nymphs on the trees in June were quite susceptible.

Insect Pests.—*Agric. Gaz. N.S.W.* **55** pt. 9 pp. 402–406, 4 figs. Sydney, 1944.

In this part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **33** 161], it is pointed out that although allowing fowls to run in *Citrus* orchards increases the fertility of the soil and reduces the necessity for cultivation, there is danger of a serious increase in infestation by Coccids, probably owing to the stirring up of fine dust. Under dry conditions, this covers the leaf surfaces and protects the scales, so that they settle and develop more freely; it also has a drying effect, which favours some Coccids, may deter natural enemies, such as Coccinellids and parasites, and reduces the efficiency of oil sprays applied against the scales by absorbing and breaking some of the oil film. It is important to reduce the amount of dust likely to be deposited to a minimum by suitable arrangement of housing and feeding systems and limitation of the number of birds. Routine spraying should be carried out whether the scale infestation is heavy or not. Thorough spraying with a white-oil emulsion (1 : 40) during February may be sufficient to control most scales, but if the white wax scale [*Ceroplastes destructor*, Newst.] is present, an application of oil in the middle of December, while the crawlers are still on the leaves, will be necessary. Effective control of mixed scale populations may be obtained by applying a white oil spray (1 : 80) twice with a few days between treatments. Where sprays of Bordeaux mixture are necessary, the white oil may be combined with it, but the final concentration of Bordeaux mixture should not exceed 2 : 2 : 80; heavier concentrations are safe, but reduce the efficiency of the oil, sometimes considerably.

Cawthron Institute, Nelson, New Zealand. Annual Report 1943–4.—35 pp. Nelson, N.Z. [1944.]

The section of this report dealing with fruit research in New Zealand (pp. 13–17) includes notes on the parasites, *Ephialtes caudatus*, Ratz., *Mastrus* (*Aenoplex*) *carpocapsae*, Cushm., and *Cryptus sexannulatus*, Grav., of the codling moth [*Cydia pomonella*, L.] ; further liberations of the first were made in February 1944 [*cf. R.A.E.*, A **32** 78], but rearing of the other two, of which 172 and 74 adults, larvae and pupae were received from Canada in April 1943, was affected by failure of the thermostat control in the insectary, and only 80 adults of *Mastrus* and 119 of *Cryptus* had been obtained from the original material by March 1944.

In the section on tomato investigations (pp. 18–20), it is reported that a spray of 6 lb. lead arsenate per 100 gals. controlled the tomato stem-borers [*Gnorimoschema plaesiosema*, Turn.], which enter the stem at the leaf bases and feed within it in the lower part of the plant, but affected the crop adversely, and that a garden in which the soil had been sterilised with steam showed little infestation by this Tineid.

Two consecutive sections are concerned with entomological work (pp. 25–30). The parasite, *Rhyssa persuasoria*, L., introduced in small numbers from Britain for the control of *Sirex noctilio*, F., about 14 years ago, has multiplied and spread remarkably, and, in view of the great importance of the extensive forests of *Pinus radiata* in New Zealand, surveys are to be made of the damage done to millable timber by the borer, and breeding and further distribution of the parasite will be carried out if necessary. *Plutella maculipennis*, Curt., was well controlled on field cruciferous crops by *Angitia cerophaga*, Grav., and *Thyraeella* (*Diadromus*) *collaris*, Grav. [*cf.* **32** 70], particularly on the North Island. Consignments of *T. collaris* were sent to Fiji for use against *P. maculipennis* there.

Glyphipteryx achyloessa, Meyr., which attacks cocksfoot grass [*Dactylis glomerata*] in the seed-producing areas and elsewhere [*cf.* **32** 78], is believed to be a native species. The moths are present from September until November ; the eggs are deposited on the blades near the base of the plant and hatch in 19–22 days. Most of the larvae burrow into the tissues of the stem, cutting the majority of the scattered vascular bundles and thus causing injury to the seed-head, before entering the hollow interior. They usually migrate upwards at first, but descend as the plants ripen, 75 per cent. being found below the crown in the underground tiller of the plants during autumn. They ascend again in winter and early spring ; pupation begins during July. Experiments on the possibility of control by cutting the stubble at different heights and at different times of year are being carried out. The Australian Stratiomyiid, *Metoponia rubriceps*, Macq., was found breeding in large numbers in damaged pasture ; Stratiomyiids are not usually injurious, but investigations in Australia show that the larvae of *M. rubriceps* insert their mouth-parts into the roots of certain pasture plants, and probably obtain nourishment from them,

Promising results were obtained in experiments with dichlorethyl ether against the common cheese mite, *Tyrolichus casei*, Oudm. (*Tyroglyphus siro*, auct.) [**33** 130], and an investigation was begun on the effect of physical factors on infestation of flax seed by *Tyroglyphus farinae*, Deg.

The breeding and liberation of the seed weevil [*Apion ulicis*, Forst.] for the control of gorse [*Ulex europaeus*] was continued in districts in which it had not become established [*cf.* **32** 78]. It was found to be widely distributed in many parts of New Zealand and to attack an increasingly large proportion of the seed-pods ; it migrates readily and in certain cases appears to have spread to farms 20 miles from the point of liberation. Adults of *Chrysomela* (*Chrysolina*) *hyperici*, Forst., which attacks the foliage of St. John's wort [*Hypericum perforatum*] in Australia, were introduced from that country and liberated during the summer.

WHITEHEAD (F. E.) & MINER (F. D.). **The Biology and Control of the Camel Cricket** *Daihinia brevipes*.—*J. econ. Ent.* **37** no. 5 pp. 573–581, 5 figs., 10 refs. Menasha, Wis., 1944.

The following is based largely on the authors' summary. *Daihinia brevipes*, Hald., a camel cricket found in the Great Plains States from North Dakota to northern Texas, was reported from Oklahoma in 1935–38 as injurious to seedlings of a variety of crops, including tomatos, watermelons, cotton and cowpeas. This Gryllacrid feeds at night, spending the day in burrows in the soil. In Oklahoma, it is found mostly in sandy environments. It was not observed to cause serious crop injury during two years of intensive study (1939–40), but its habits indicate that it may be injurious under certain conditions. In addition to growing plants, it fed on dry sticks, weed seeds, rabbit pellets, and insects, including examples of its own species. It overwinters in burrows as a semi-active nymph. The adults emerge about 1st May, and oviposit throughout June. The eggs, laid in the soil surrounding the burrow, hatch in late September, and the nymphs dig their way to the soil surface. There is one generation in a year. Nocturnal activity was not closely correlated with weather, and migration appeared to be very limited. The burrows increase in depth from 3 ins. in February to 1–5 ft. in June. The number of eggs found in the soil round each burrow averaged 26·8.

Baits of 100 lb. wheat bran, 2 U.S. quarts sodium arsenite and 12 U.S. gals. water, with or without 1 U.S. gal. blackstrap molasses, gave satisfactory control when used at the rate of 15 lb. dry weight per acre, and it is recommended that 2–4 applications should be made in a period of 12–15 days, regardless of temperature.

REINHARD (H. J.). **The Life History of** *Phyllophaga calceata* **and of** *P. micans*.—*J. econ. Ent.* **37** no. 5 pp. 581–587, 15 refs. Menasha, Wis., 1944.

The author describes the methods used in the laboratory for rearing *Lachnosterna* (*Phyllophaga*) *calceata*, Lec., adults of which commonly feed on post oak [*Quercus stellata*] and elm throughout the eastern, humid region of Texas, and *L.* (*P.*) *micans*, Knoch, which has been recorded in the United States from Massachusetts to Iowa and south to Louisiana and Georgia, and in season of heavy flight causes serious damage to pecan, post oak, elm and persimmon in the humid part of Texas. The following is substantially his summary of the life-histories of the two species in Texas. Both have life-cycles of two years. The adults of *L. calceata* commonly emerge from the pupal cells during the latter half of March, and stragglers may remain active in the field until early summer. Oviposition is in progress by mid-April and continues throughout May. The larvae feed throughout the summer, moult twice and become full-grown by November. They overwinter and remain quiescent during the following spring and early summer. The egg, larval and pupal stages averaged about 35, 429 and 27 days, respectively, and pupation usually occurs during August. The adults overwinter within the pupal cells and emerge in the following spring. The adults of *L. micans* emerge chiefly in April, and eggs are usually present during the latter part of that month and throughout May. The larvae feed throughout the summer and become full-grown by September or October. They overwinter and remain quiescent until mid-July, when pupation begins. The durations of the egg, larval and pupal stages averaged about 25, 413 and 23 days, respectively, and pupae are present during August and September. The adults remain within the pupal cells until the following spring.

Anderson (R. F.). **The Relation between Host Condition and Attacks by the Bronzed Birch Borer.**—*J. econ. Ent.* **37** no. 5 pp. 588–596, 4 figs., 12 refs. Menasha, Wis., 1944.

In view of divergent opinions as to whether *Agrilus anxius*, Gory, can kill healthy birch trees or infests them only when they are decadent or dying [*cf. R.A.E.*, A **32** 327, 328, etc.], experiments, which are described in detail, were carried out in northern Minnesota in 1941–42. The most abundant trees in the forests in this area are aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*), and the Buprestid breeds in both, as well as in other trees. Young vigorous uninfested trees of both species were injured in various ways, so as to produce decadent conditions, and their attractiveness to the beetles and suitability for the development of the larvae were observed and compared with those of uninjured trees.

The following are substantially the author's summary and conclusions. *Agrilus anxius* is a subcortical-feeding insect that is not very aggressive and can successfully develop only in extremely decadent trees. The data obtained show that the adults are attracted to suppressed, girdled, or topped and felled aspen and birch trees and oviposit on them. Trees that had ceased to produce radial increment (felled or topped trees and portions of the stem below the girdle on girdled trees) were the most suitable for attack. Decadent trees that were still growing in diameter (suppressed trees and portions of the stem above the girdle on recently girdled trees) were only lightly attacked. Even the poorest of the growing trees were unsuitable for the development of the larvae, as were also trees that had been dead so long that the phloem tissues were dead (brown). These results suggest that when *A. anxius* is found in dying trees it should not be considered as the primary cause of death until all other possible causes have been investigated.

Fulton (R. A.) & Busbey (R. L.). **Effect of Soils, Cover Crops, and Foliage on Concentration of HCN in *Citrus* Fumigation.**—*J. econ. Ent.* **37** no. 5 pp. 597–598, 1 fig., 1 ref. Menasha, Wis., 1944.

Earlier work on the control of *Aonidiella aurantii*, Mask., on *Citrus* in California by fumigation with hydrocyanic acid gas [*R.A.E.*, A **30** 433] showed that though even distribution of the gas in the tent could be obtained by means of a blower applicator, samples taken 30 seconds after its release accounted for only 60–70 per cent. of the HCN introduced. An experiment was therefore undertaken to determine the effect of initial sorption of gas by the cover crop, soil and tree foliage on the concentration during fumigation. From the results obtained, it is concluded that the loss due to sorption by such surfaces is negligible compared with the probable initial loss through the tent fabric when the fumigant is released.

Graham (L. T.), Sandstedt (R. M.) & Tate (H. D.). **Wheat Flour as an Adhesive for Sprays.**—*J. econ. Ent.* **37** no. 5 pp. 599–604, 5 refs. Menasha, Wis., 1944.

The following is substantially the authors' summary. Laboratory and greenhouse tests were conducted to determine the effect of wheat flour, alone or with certain other materials, on the tenacity of spray components applied in the form of suspensions. Insoluble copper sulphate (3 lb. per 100 U.S. gals.) was used as the spray component or indicator in all sprays, since its presence could be readily and accurately determined by chemical analysis.

Wheat flour (1 lb. per 100 U.S. gals.) gave a significant increase in tenacity in the laboratory; and the addition of lime to the flour gave a significant increase over flour alone. The optimum amount of lime ranged from about

0·09 to 0·36 gm. per 3 litres (equivalent to 0·4–1·6 oz. per 100 U.S. gals. spray). Smaller or greater quantities gave reduced values. The addition of acetic acid or sodium hydroxide to the flour improved tenacity only slightly, if at all. On a paraffin surface, soy-bean flour (4 oz. per 100 U.S. gals.) was superior to wheat flour (1 lb.). With the addition of lime, however, they were equally effective. On a cellulose-nitrate surface there was an indication that soy-bean flour alone was slightly superior to no adhesive, and that wheat flour alone was superior to soy-bean flour alone, but these results were not conclusive. When combined with lime, wheat flour was superior to soy-bean flour on this surface. When used with lime, the optimum quantity of wheat flour was found to be approximately 8 oz. or more per 100 U.S. gals. ; and of soy-bean flour, 1 oz. or more per 100 U.S. gals. Hardness of water had little effect on tenacity when flour was used alone, but in combination with lime the use of tap water in diluting the spray resulted in a markedly higher tenacity index than when distilled water was used. Of the various components of flour, gliadin appeared to have the most effective adhesive properties.

The results of spray tests on potato plants grown in the greenhouse indicated that the addition of flour alone increased tenacity only slightly, whereas the addition of flour plus lime increased it markedly. The combination of wheat flour and lime was significantly better than soy-bean flour alone or in combination with lime. The addition of lime to soy-bean flour increased tenacity only slightly, if at all.

Sweetman (H. L.) & Bourne (A. I.). **The protective Value of Asphalt laminated Paper against certain Insects.**—*J. econ. Ent.* **37** no. 5 pp. 605–609, 2 refs. Menasha, Wis., 1944.

The following is based on the authors' summary. A 2-ply asphalt-laminated Kraft paper used as a wrapping material offered considerable resistance to penetration by cockroaches (*Periplaneta americana*, L., *P. australasiae*, F., *Blattella germanica*, L., and *Supella supellectilium*, Serv.) and Lepismids (*Lepisma saccharina*, L., *Thermobia domestica*, Pack., and *Ctenolepisma quadriseriata*, Pack.). *P. americana* and *T. domestica* damaged it the most. An adhesive of bone glue and petroleum asphalt emulsion, which is applied to strips of the laminated paper used for sealing the wrappings, formed an attractive food to the insects, but was much less attractive after treatment with a solvent consisting of a 15 per cent. solution of equal weights of Glyoxol (dialdehyde) and chrome alum, with which the strips are moistened before being applied. Only the laminated paper surfaces are exposed to the insects on sealed packages. Termites (*Reticulitermes flavipes*, Koll.) constructed tubes over the Kraft paper and penetrated it at times, but the asphalt layer seemed to offer some resistance to penetration.

A fungicide, Dowicide G (pentachlorphenol), in the adhesive offered little protection against fungi in moist environments. At 1 per cent. it greatly reduced the attractiveness of the adhesive to the cockroaches and Lepismids, but *Thermobia* and *Lepisma* still fed extensively on the adhesive during a seven-day test. Termites formed tubes over, but did not injure, paper in contact with 0·3 and 1 per cent. of the fungicide in the adhesive, but damaged paper in contact with weaker concentrations.

Alexander (C. C.), Cassil (C. C.), Dean (F. P.) & Newcomer (E. J.). **The Use of Oleic Acid and Aluminum Sulfate to increase Deposits of Nicotine Bentonite.**—*J. econ. Ent.* **37** no. 5 pp. 610–617, 1 fig., 6 refs. Menasha, Wis., 1944.

In 1941, sprays of nicotine bentonite prepared by mixing nicotine sulphate and bentonite dry [*cf. R.A.E.*, A **27** 133] or in the tank [*cf.* **31** 105] did not

give satisfactory results against *Cydia* (*Carpocapsa*) *pomonella*, L., on apple under the arid conditions of the Pacific Northwest, but promising results were obtained in laboratory experiments in the winter of 1941–42 with a spray of 3 lb. dry-mixed nicotine bentonite containing about 8·5 per cent. nicotine, 1 U.S. quart emulsible summer oil and 1 oz. aluminium sulphate per 100 U.S. gals. The ingredients could be put directly into the tank without preliminary manipulation and the spray gave about the same deposit on apples as one containing 6 lb. nicotine bentonite with soy-bean oil and was more effective in larvicide tests, probably because the deposit was smoother and more even. Bentonite of two particle sizes was used (average 13·7 and 10·3μ), and though there was little difference in effectiveness, it was believed that this would be increased by still smaller particle size. In field experiments in 1942, therefore, nicotine bentonite prepared by mixing nicotine sulphate and bentonite was micronised. The resulting product had a nicotine content of 10 per cent., and an average particle size of 6·3μ. A spray consisting of 3 lb. of this material, 1 U.S. quart emulsible summer oil and 1 oz. aluminium sulphate per 100 U.S. gals. permitted more entries than the standard lead-arsenate spray in all orchards, but the difference was significant in only one.

In the Pacific Northwest, fatty acids are frequently used with metallic salts and mineral oils in lead-arsenate sprays to obtain good deposits, and in laboratory experiments with nicotine bentonite, oleic acid proved superior for this purpose to naphthenic, stearic or palmitic acids, and aluminium sulphate to zinc sulphate. Sprays incorporating these materials were prepared by stirring 3 lb. nicotine bentonite into about 2 U.S. gals. water, adding the oleic acid in mineral oil and mixing with a wire beater, and then adding the aluminium sulphate dissolved in a little water. The mixture was either poured or injected into the spray tank.

In sprays containing nicotine bentonite, nicotine that dissolves in the water is largely lost when the water runs off after application. In laboratory tests, the solubility of the nicotine was not affected by the proportions of oleic acid and oil, but increased with the proportion of aluminium sulphate. By doubling the amount of nicotine bentonite, the percentage of nicotine dissolved was reduced by about a third. When a spray consisting of 3 lb. nicotine bentonite (1 U.S. pint nicotine sulphate : 5 lb. bentonite), containing 9·3 per cent. nicotine, per 100 U.S. gals., and the other adjuvants, was compared with a similar spray of 4 lb. nicotine bentonite (1 : 10), containing 4·8 per cent. nicotine, it was found that they contained about the same percentage of insoluble nicotine. The reaction of the materials is not well understood, but increased deposits could be obtained only by adding both aluminium sulphate and oleic acid ; without the sulphate, spraying for six seconds instead of three did not appreciably increase the deposit. When either 0·5 or 1 U.S. pint oleic acid was used, the best deposits were given by adding the aluminium sulphate at the rate of 2 oz. per 3 lb. nicotine bentonite. Sprays containing nicotine bentonite (1 : 10) and prepared in the same way as the 1 : 5 mixture gave light deposits, but these were increased by mixing the nicotine bentonite in oil and oleic acid before adding the water and sulphate. The amount of nicotine in this spray was not sufficient to prevent swelling of the bentonite, and when this occurred, a good deposit was not obtained. In larvicidal tests nicotine bentonite (1 : 5) was more effective when mineral oil, oleic acid and aluminium sulphate were added than when applied with emulsible oil and the sulphate. Sprays containing 3 lb. nicotine bentonite (1 : 5) and 4 lb. (1 : 10) per 100 U.S. gals. were equally effective.

In field tests in 1943, sprays of 3 lb. nicotine bentonite (1 : 5) containing 8·1 per cent. nicotine and with an average particle size of 3·9μ, $\frac{1}{4}$ U.S. pint oleic acid and 2 oz. aluminium sulphate per 100 U.S. gals. gave good deposits and were as effective as the standard lead-arsenate sprays, but the results with sprays of 4 lb. nicotine bentonite (1 : 10) containing 4·3 per cent. nicotine and with an average particle size of 6·9μ, $\frac{1}{3}$ U.S. pint oleic acid and 2 oz. aluminium sulphate per 100 U.S. gals. were less consistent. The deposit from the spray of

nicotine bentonite (1 : 5) was improved when the oleic acid and aluminium sulphate were mixed with the dry nicotine bentonite before they were added to the water, and it was found that this should be done at least a day before the spray is applied. Just before application, the mixture was added to several gallons of water, followed by 1–2 U.S. quarts mineral oil, and the whole injected into the spray tank, so that it was forcibly mixed with water in the tank. In one case, the spray of 4 lb. nicotine bentonite (1 : 10) was prepared by dissolving the aluminium sulphate in water before the mixture of oleic acid and nicotine bentonite and the oil were added, and it was found that this prevented the swelling of the bentonite.

The deposits on the fruit at harvest were satisfactorily removed by washes used for cleaning apples sprayed with lead arsenate.

YOTHERS (M. A.) & CARLSON (F. W.). **Repellency of Pyrethrum Extract and other Materials to full-grown Codling Moth Larvae.**—*J. econ. Ent.* **37** no. 5 pp. 617–620, 1 ref. Menasha, Wis., 1944.

The following is based on the authors' summary. Tests have been carried out in Washington since 1936 to find a material repellent to larvae of the codling moth [*Cydia pomonella*, L.] as they search for cocooning quarters. Bands of corrugated paper, impregnated with the test materials, were placed half way round the trunks of apple trees, and the repellent effect was estimated by comparing the numbers of larvae taken in these treated half bands with those in corresponding untreated halves at the end of 30, 60 and 90 days.

Of some 250 formulae tested, the best results were obtained with combinations of 5 per cent. pyrethrum extract with either 5 or 10 per cent. cottonseed oil, emulsified with blood albumen. The pyrethrum extract used had a pyrethrin content of 2·5 per cent. by weight ; it was highly repellent when undiluted but the repellent effect decreased with long periods of exposure. Undiluted cottonseed oil was considerably less repellent, although its repellency increased with longer exposure. Kerosene alone was neither repellent nor attractive but reduced the attractiveness of pyrethrum extract when combined with it. Dilutions of 1 per cent. dinitro-o-cresol, alone and in combination with 10 or 20 per cent. cottonseed oil, appeared slightly attractive during a 30-day exposure, but showed slight repellency over longer periods. Nicotine sulphate at 1 per cent., alone or mixed with cottonseed oil, was at most slightly repellent, and stove oil, used at 10 per cent., was not repellent.

BARNES (M. M.). **A Dust Experiment for Codling Moth Control in a heavy Infestation.**—*J. econ. Ent.* **37** no. 5 pp. 620–623, 2 refs. Menasha, Wis., 1944.

The following is based on the author's summary. Two dust mixtures consisting of lead arsenate, Black Leaf 155 [14 per cent. fixed nicotine] and micronised dusting sulphur (20 : 20 : 60 and 20 : 10 : 70) and one of lead arsenate, Black Leaf 155 and a proprietary diluent (20 : 20 : 60) were applied eight times to apple trees in an orchard in Orleans County, New York, that was relatively heavily infested with *Cydia* (*Carpocapsa*) *pomonella*, L. All plots had received a calyx spray of lead arsenate and also received two cover dusts of lead arsenate and micronised dusting sulphur (20 : 80) during periods when moth activity was low. The dusts were applied from both sides of the tree at an average rate of 38 oz. per tree per application.

Injury in the dusted plots at harvest ranged from 15 to 20 per cent. infested fruits with approximately 30 per cent. superficially injured ; in no case were differences between treatments mathematically significant. The degree of control obtained indicates that under similar conditions, a dusting programme of this type should be adopted only if it is not possible to spray, but that it

will effect a considerable reduction in damage. None of the samples taken at harvest showed residues of arsenic (As_2O_3) that exceeded the legal tolerance (0·025 grain per lb. fruit), and this is thought to be largely attributable to the absence of dew when most of the applications were made.

BAKER (H.). **Effect of scraping and banding Trees upon the Numbers of transforming and hibernating Codling Moth Larvae.**—*J. econ. Ent.* **37** no. 5 pp. 624–628, 13 refs. Menasha, Wis., 1944.

The following is partly based on the author's summary. The effect of scraping and banding apple trees on the ability of transforming (non-hibernating) larvae of the codling moth [*Cydia pomonella*, L.] to give rise to adults and of non-transforming larvae to enter hibernation was studied in replicated plots in commercial orchards in Kansas during the seasons of 1938, 1939 and 1940. It was estimated that the numbers of larvae taken in the untreated corrugated paper bands during the three seasons represented 29·1 per cent. of the numbers that left the fruit, 67·7 per cent. of the numbers that developed into moths or entered hibernation, and 86·3 per cent. of the numbers caught in the bands plus the numbers found in hibernation after harvest. The second estimate is believed to indicate more accurately than the others the actual effect of banding on moth populations. It was found that under the conditions of the Missouri River valley, there is a very heavy mortality between the time when the larvae leave the fruit and the time when they emerge as adults or enter hibernation. The percentages of larvae leaving the fruit that gave rise to adults and entered hibernation were, respectively, 17·2 and 18 on the control trees, 14 and 6·7 on the trees that were scraped, and 9·3 and 4·6 on the trees that were scraped and banded. The effect of scraping and banding on moth emergence and hibernation was much greater than that indicated by the percentage of the larvae leaving the fruit that was caught in bands. Transforming larvae were found to spin cocoons in greatest numbers in the lower third of the trees and under bark, in crotches or forks of limbs, or in pruning or other scars.

KING (H. L.) & FREAR (D. E. H.). **Relation of chemical Constitution of some N-Heterocyclic Compounds to Toxicity as Fumigants.**—*J. econ. Ent.* **37** no. 5 pp. 629–633, 1 fig., 9 refs. Menasha, Wis., 1944.

The following is substantially the author's summary. Experiments are described in which 13 pyridine derivatives were tested in the laboratory as fumigants against *Tetranychus telarius*, L., 28 against adults of *Oncopeltus fasciatus*, Dall., and 34 against adults of *Tribolium confusum*, Duv. Emphasis was placed on a study of the relationship between toxicity and length, position and type of side chain. In all the tests carried out, it was evident that in a series of 2-*n*-alkyl-pyridines a pronounced peak of toxicity occurred at the propyl- or butyl-derivatives. Alkyl pyridines with side chains in the 4-position were more toxic than the 2-substituted isomers, and compounds with normal side chains were usually more toxic than the branched isomers. The two alkyl piperidines available were more toxic than the corresponding pyridines. The relative toxicities of the materials tested against the mite showed a high degree of correlation with the action of the same compounds against the two insects.

KING (H. L.) & FREAR (D. E. H.). **Relation of chemical Constitution of some N-Heterocyclic Compounds to Toxicity against** *Tribolium confusum*.—*J. econ. Ent.* **37** no. 5 pp. 634–637, 1 fig., 14 refs. Menasha, Wis., 1944.

The following is substantially the authors' summary. Seventeen salts of various pyridine derivatives were prepared and tested in flour against adults of *Tribolium confusum*, Duv. A series of alkyl pyridine sulphates gave results

indicating that the salts with short alkyl side chains were more toxic than those with long chains. The toxicity of these compounds appeared to be due rather to the material ingested than to contact action. A series of alkyl pyridine copper chloride double salts appeared to be completely repellent to the beetles. The results obtained with three additional salts of 4-*n*-propyl-pyridine indicated that the picrate, salicylate and the zinc chloride double salt were slightly toxic or partly repellent or both.

King (H. L.), Frear (D. E. H.) & Dills (L. E.). **Relation of chemical Constitution of some N-Heterocyclic Compounds to Toxicity to** *Aphis rumicis*.—*J. econ. Ent.* **37** no. 5 pp. 637–640, 1 fig., 8 refs. Menasha, Wis., 1944.

The following is substantially the authors' summary. Pyridine and 36 related compounds were tested in sprays as contact insecticides against *Aphis rumicis*, L., in the laboratory. In a series of 2-*n*-alkyl-pyridines, compounds with five or more carbon atoms in the side chain were much more toxic than those with short chains, the toxicity increasing with the length of the substituent group. A series of 2-*n*-alkyl-6-methyl pyridines gave results closely parallel to those given by the 2-*n*-alkyl-pyridines. A series of 4-*n*-alkyl-pyridines was more toxic than the corresponding 2-*n*-alkyl-compounds. Normal or straight-chain alkyl compounds were generally more toxic than the branched chain isomers. The addition of an amino group to the pyridine nucleus increased the toxicity much more than the addition of a methyl group in the same position. Hydrogenation of two alkyl pyridines to the corresponding piperidines did not increase the toxicity. Phytotoxicity was generally parallel to aphicidal action.

Dills (L. E.), Frear (D. E. H.) & King (H. L.). **Mercury Substitutes for Cabbage Maggot Control.**—*J. econ. Ent.* **37** no. 5 pp. 640–642, 10 refs. Menasha, Wis., 1944.

The results are given of two experiments carried out in Pennsylvania in 1943 in which 36 treatments and 22 different materials, including several chlorinated hydrocarbons and N-heterocyclic compounds, were applied to radishes under field conditions for the control of *Hylemyia brassicae*, Bch. A dust of 10 per cent. mercurous chloride (calomel) in bentonite gave the best control without plant injury of 28 treatments applied when the first pair of primary leaves was developing, and a spray of dichlorethyl ether (1 : 200 or 1 : 400) was the best of 13 treatments applied to older plants. Several pyridine derivatives were found to be quite effective, but caused considerable plant injury. The smallest percentage infestation followed the use of dusts containing 10 per cent. dormant tar oil or 2-ethyl-pyridine sulphate, but injury to the plants was very severe. However, preliminary tests indicated that these two treatments and a dust of 2-*n*-hexyl-pyridine sulphate, which was also effective against the maggots, could be safely used on cabbage plants.

Dudley jr. (J. E.) & Bronson (T. E.). **Strength of Rotenone Dust Mixtures and Rate of Application in Pea Aphid Control.**—*J. econ. Ent.* **37** no. 5 pp. 643–646, 1 fig. Menasha, Wis., 1944.

From the results of field experiments carried out in Wisconsin in 1942 and 1943 to determine the percentage of rotenone best for use in derris dust mixtures for the control of *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on peas for canning and the quantity of dust to apply per acre, the authors conclude that when an oil-conditioned dust mixture is employed, the quantity of rotenone applied per acre determines, within limits, the resulting mortality of the Aphid. When as much as 0·3 lb. rotenone per acre is used, it makes little difference whether a dust mixture of high rotenone content is applied at a low rate, or

a mixture of lower rotenone content at a higher rate, but when only 0·15 lb. rotenone or less per acre is applied, a mixture of high rotenone content at a low rate is preferable. A marked decrease in mortality of the Aphid occurs when the rotenone content of an oil-conditioned dust mixture is decreased from 0·375 to 0·25 per cent. or lower. It is also concluded from the results obtained in 1943 that when either 0·15 lb. or 0·3 lb. rotenone is applied per acre, a decrease in the rotenone content of the dust mixture may be partly offset by an increase in the rate of application, but that this relationship fails to hold when only 0·075 lb. rotenone per acre is applied in mixtures of the rotenone contents used.

DIETER (C. E.), JANES (R. L.), WILSON (H. F.) & BURDICK (H. L.). **Laboratory Technique for testing insecticidal Dusts for Pea Aphid Control.**—*J. econ. Ent.* **37** no. 5 pp. 646–651, 2 figs., 1 ref. Menasha, Wis., 1944.

The authors describe procedures for rearing the pea Aphid [*Macrosiphum onobrychis*, Boy.] in the laboratory and testing insecticidal dusts for its control that have given satisfactory results in Wisconsin over a period of five years. Accounts are also given of the methods used in the production of pea plants for rearing and testing the Aphids, the dusting apparatus and the preparation of dust mixtures, and the accuracy of the testing method is discussed from the results of tests with various cubé dusts.

WILSON (H. F.), JANES (R. L.) & CAMPAU (E. J.). **Electrostatic Charge Effects produced by insecticidal Dusts.**—*J. econ. Ent.* **37** no. 5 pp. 651–655, 1 fig., 1 ref. Menasha, Wis., 1944.

The following are substantially the authors' conclusions. A method is described for recording the electrostatic charges of blown dust [*cf. R.A.E.*, A **29** 569], with which consistent replicated readings are possible. A preliminary study of samples of some commercial powdered insecticides and fungicides showed that there is a variation in the capacity of different mineral combinations to produce electrostatic charges, and that the sign of charge for all those studied is positive. Some differences in dispersion apparently influenced by the degree of charge were also noticed, but it is not known whether they would be significant in the control of insects or plant diseases. Finely-ground plant and animal tissues of a granular nature produced electrostatic charges, and the charges produced by plant materials appeared to increase with the average particle size. When powdered dusts producing electrostatic charges were blown through tubes made of different metals, no noticeable change in the sign of charge of the dust was observed. When dusts capable of developing electrostatic charges were blown against plants, an induced charge opposite to that of the dust was imparted to the plant and carried for the full length of the plant.

WENE (G.) & HANSBERRY (R.). **Toxicity of Cryolite to Mexican Bean Beetle Larvae.**—*J. econ. Ent.* **37** no. 5 pp. 656–659, 4 figs., 4 refs. Menasha, Wis., 1944.

An account is given of laboratory tests in which larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] were allowed to feed for five days on the lower surface of bean leaves sprayed with natural cryolite containing at least 90 per cent. sodium fluoaluminate. The results showed that this material was highly toxic, although slow-acting and repellent. Larvae in the first three instars were more susceptible than those in the fourth, four days of feeding on deposits of 0·056–0·1002 mg. per sq. cm., being necessary to obtain kills of 60 per cent. or more with the latter, whereas two days gave similar results with the former. Time-mortality lines, plotted according to the method of probits, curved upwards

and are considered to be shaped by the nature of the feeding rather than by the nature of the toxic action of ingested cryolite. Mortality was increased more by extended time of exposure to a given dosage than by increasing the deposit by a proportional amount.

HAMBLETON (E. J.). *Heliothis virescens* **as a Pest of Cotton, with Notes on Host Plants in Peru.**—*J. econ. Ent.* **37** no. 5 pp. 660–666, 24 refs. Menasha, Wis., 1944.

The author discusses the distribution and food-plants of *Heliothis virescens*, F., which is well known as a pest of tobacco in the United States and Cuba and has of fairly recent years been recorded on cotton in Louisiana [*R.A.E.*, A **24** 522], St. Croix [**11** 513] and Porto Rico. Local outbreaks on cotton occurred in 1935 in two localities in São Paulo, Brazil [*cf.* **25** 590], where this crop was a comparatively new introduction, but had not recurred in one of them up to 1939, and the Noctuid has not been observed in the older cotton-growing areas of the country. *H. armigera*, Hb., is rare on cotton in Brazil, and it is thought that both species are controlled by natural enemies. In 1928, *H. virescens* was observed on cotton in Peru [*cf.* **17** 483], and in 1939–43, it was the most destructive pest of cotton in the Cañete Valley [*cf.* **29** 11, 509; **31** 516; **32** 428], where this crop had replaced almost all others. Conditions there are suitable for a long-staple variety, which has a long growing season, and this favoured the infestation. Attempted control by arsenical dusts, applied from the ground or from aircraft, was ineffective [*cf.* **31** 516], as was the planting of chickpea (*Cicer arietinum*) as a trap-crop [*cf.* **29** 510], and natural enemies were unable to multiply sufficiently to be of much value. Flax was meanwhile introduced as a winter crop and was frequently followed by various summer crops, including maize, and by 1940 conditions were more suitable for the increase of natural enemies. The predacious bugs, *Nabis punctipennis*, Blanch., and *Paratriphleps laeviusculus*, Champ., which destroy the young larvae and eggs, respectively, and of which the former proved the more useful, multiplied, and parasitism by two or more Tachinids of the genus *Archytas* became noticeable. Growers were recommended not to dust cotton during the 1942–43 season, and from the end of 1942, infestation decreased rapidly. Field counts indicated that the larvae of the first generation were almost all destroyed by *N. punctipennis* and a satisfactory crop was obtained. It is unlikely that *H. virescens* will again be so injurious unless growers resort to the earlier agricultural practices.

The author considers that the lack of earlier or more frequent records of this Noctuid on cotton is not due to any recent change in its feeding habits or the development of a distinct biological race, but most probably to failure to distinguish it from *H. armigera*. An annotated list of the plants on which it has been observed in Peru is appended.

APPLE (J. W.) & RICHARDSON (C. H.). **Comparative Toxicities of Copper Hydroarsenate and Copper Hydroarsenate-arsenite Mixtures.**—*J. econ. Ent.* **37** no. 5 pp. 666–671, 12 refs. Menasha, Wis., 1944.

The following is based on the authors' summary. An account is given of laboratory tests in which dusts of copper hydroarsenate precipitated on calcium sulphate and containing 40 per cent. basic cupric arsenate and of copper hydroarsenate-arsenite precipitated on calcium sulphate and containing a mixture of 32 per cent. basic cupric arsenate and 8 per cent. basic cupric arsenite were compared toxicologically on a weight basis with certain standard arsenical compounds. Their relative toxicities were determined on larvae of *Leptinotarsa decemlineata*, Say, *Pieris rapae*, L., and *Heliothis armigera*, Hb., and adults of *Melanoplus differentialis*, Thos., and *Diabrotica duodecimpunctata*, F. A

quantitative individual dosage technique was employed on the first four species. The greatest susceptibility to the two new products was shown by *Melanoplus*, followed by *Leptinotarsa*, *Pieris* and *Heliothis*. The first was more toxic than the second to *Leptinotarsa*, but less effective against *Pieris* and *Diabrotica*. There was no significant difference in the action of these materials on *Melanoplus*. Both had little effect on *Heliothis*, and no conclusions could be drawn as to relative toxicity.

Calcium arsenate was less effective than the two new products against *Pieris* and more effective against *Leptinotarsa* and *Heliothis*. All three had similar toxic effects on *Melanoplus*, while calcium arsenate was about as toxic as the mixed product, but more toxic than copper hydroarsenate, to *Diabrotica*. Lead arsenate was less effective than the new products against *Melanoplus* and *Diabrotica*, but more effective against *Leptinotarsa* and *Heliothis*. Against *Pieris*, the mixed product and lead arsenate showed similar toxicity, and both were more toxic than copper hydroarsenate. Paris green proved the most toxic compound to all the insects tested. Two further products, cupric meta-arsenite and a reaction product of Paris green and calcium arsenate were nearly as toxic as Paris green to *Leptinotarsa* and *Diabrotica*, the only insects against which they were tested.

Experiments with larvae of *Leptinotarsa* and *Heliothis* showed that the two new copper arsenicals had a repellent effect, which was greater in the case of the mixed product than in copper hydroarsenate. Phytotoxicity tests in the laboratory showed that they were much less injurious to bean foliage than the five other arsenicals.

SWINGLE (M. C.), MAYER (E. L.) & GAHAN (J. B.). **Further Tests of synthetic organic Compounds as Insecticides.**—*J. econ. Ent.* **37** no. 5 pp. 672–677, 3 refs. Menasha, Wis., 1944.

The following is the author's summary of these further experiments [*cf. R.A.E.*, A **32** 367]. Sixty-four synthetic organic compounds were tested for insecticidal action against from four to eight species of insect pests. Fourteen were toxic to at least a few species and are discussed in some detail. The most toxic compounds were 4–bromoacetophenone, a volatile fumigant and contact insecticide; p-bromo-N-ethylbenzenesulphonamide, a fairly toxic stomach insecticide but injurious to foliage; 4, 6-dinitro-o-cresol propionate [numbered with OH as 1] and 2, 4-dinitrophenol propionate, very toxic compounds but injurious to foliage; and 4-methylcyclohexanone semicarbazide, a fairly toxic stomach insecticide but injurious to foliage. Fifty compounds were relatively non-toxic and are listed by name only.

HILLS (O. A.), ROMNEY (V. E.) & MCKINNEY (K. B.). **Effect of *Empoasca solana* on Sugarbeets grown for Seed.**—*J. econ. Ent.* **37** no. 5 pp. 698–702, 2 figs., 2 refs. Menasha, Wis., 1944.

The following is substantially the authors' summary. The production of sugar-beet seed in outdoor cages at Phoenix, Arizona, was materially reduced by *Empoasca solana*, DeLong. There seemed to be a tendency for this Jassid to cause a slight increase in the proportion of small seed balls, but in no case was there any appreciable reduction in the viability of the seed produced on infested plants. These facts, together with observations of the plants involved and the habitat of the insects, both in the field and in the cages, led to the conclusion that this leafhopper feeds largely on the vegetative parts of the plants and that the damage attributable to it consists chiefly in devitalisation of the plants. In no instance was there any evidence of a diseased condition or toxic effect attributable to it.

BEARD (R. L.). **Susceptibility of Japanese Beetle Larvae to** *Bacillus popilliae*.—*J. econ. Ent.* **37** no. 5 pp. 702–708, 2 figs., 11 refs. Menasha, Wis., 1944.

The results are given of laboratory experiments on the numerical relationships of the spores of *Bacillus popilliae* and the incidence of the milky disease that it causes among larvae of the Japanese beetle [*Popillia japonica*, Newm.]. When various known doses of spores were injected into the body cavities of third-instar larvae and these were examined for disease after storage at 78°F. for two weeks, it was found that a straight line was obtained when the percentage of diseased larvae in probits was plotted against the logarithm of the dose. The same relationship was obtained when the larvae were kept in soil containing food material and different concentrations of spores. When different doses of spores were injected into the alimentary tract, the incidence of disease was much lower than when they were injected into the haemolymph, and the correlation between it and concentration of spores in the inoculum was less well defined.

A preliminary experiment in which larvae that failed to acquire the disease after one inoculation were reinoculated with higher dosages of spores indicated that these individuals were not immune, but acquired the disease in a dosage-response. The level of infection, however, was lower than following the original inoculation, suggesting more resistance than is found in an unselected population. These results were not confirmed in a more detailed experiment, but the results of the two tests seemed sufficiently definite to indicate that grubs may manifest an actual resistance to the disease and that this resistance and reduced potency of the disease organism may act independently in causing an incidence of disease lower than expected.

STITT (L. L.). **Difference in Damage by three Species of** *Lygus* **to Alfalfa Seed Production.**—*J. econ. Ent.* **37** no. 5 p. 709, 3 refs. Menasha, Wis., 1944.

In field-cage tests in California in 1942 on the effect of feeding by *Lygus hesperus*, Knight, *L. oblineatus*, Say, and *L. elisus*, Van D., on the seed production of lucerne [*cf. R.A.E.*, A **29** 441, 567, etc.], pairs of adults of each species were confined separately over stems in full bloom, when the very small embryo seed pods were appearing, and observed daily for two weeks, dead individuals being replaced by similar living ones. The pods that produced seeds, flowers that failed to produce pods and non-viable and normal seeds were counted, and the percentages of pods set and of non-viable seed were calculated. Analysis of the results showed that all three Capsids reduced the setting of pods and increased the percentage of non-viable seeds significantly. The decreases in mean percentage of pods set, associated with the respective species did not differ significantly from one another. *L. hesperus* caused significantly more non-viable seed than *L. elisus*, but the difference between *L. oblineatus* and either of the other species was not significant.

GRAYSON (J. M.). **Tests of poisoned Baits to control the Tobacco Budworm.**—*J. econ. Ent.* **37** no. 5 pp. 709–710, 5 refs. Menasha, Wis., 1944.

In laboratory tests carried out in Virginia in 1943 on poison baits placed on tobacco buds for the control of larvae of *Heliothis virescens*, F., four materials were compared with the standard bait containing lead arsenate [*cf. R.A.E.*, A **31** 251]. All were diluted with maize meal (1 : 75). Observations on mortality after exposure for three days showed no significant difference in effectiveness between basic copper arsenate (about 94 per cent. pure) and lead arsenate. Alorco cryolite (85 per cent. sodium fluoaluminate) and Dutox (72 per cent. barium fluosilicate and 8 per cent. sodium fluosilicate) were significantly less effective, and Baricide (94 per cent. barium carbonate) was completely ineffective.

Carlson (F. W.), Cassil (C. C.) & Yothers (M. A.). **Ether-extract Content of Codling Moth Cocoons.**—*J. econ. Ent.* **37** no. 5 p. 711, 3 refs. Menasha, Wis., 1944.

In the course of attempts in Washington to develop a spray to destroy hibernating larvae of *Cydia* (*Carpocapsa*) *pomonella*, L. on apple trees [*cf. R.A.E.*, A **32** 273, etc.], it was found that several chemicals were highly toxic to naked larvae, but harmless to those in cocoons, and investigations were therefore carried out on the chemical composition of the overwintering cocoons. Two samples of cocoons spun on glass were extracted with ether and were found, respectively, to contain 22·6 and 30·8 per cent. of wax and fat. For normal cocoons, the figure would probably vary with the amount of extraneous material incorporated in them on the tree and in the soil.

Flanders (S. E.). **Olfactory Responses of parasitic Hymenoptera in Relation to their Mass Production.**—*J. econ. Ent.* **37** no. 5 pp. 711–712, 9 refs. Menasha, Wis., 1944.

The author reviews cases from the literature and his own observation of the effect of odours on the reproduction of parasitic Hymenoptera, from which he concludes that they are of paramount importance in this connection and that reproduction of such insects in the laboratory can be either stimulated or repressed by the manipulation of odours.

Grayson (J. M.). **Two important Parasites of the Tobacco Budworm.**—*J. econ. Ent.* **37** no. 5 pp. 712–713, 4 refs. Menasha, Wis., 1944.

There are two important parasites of *Heliothis virescens*, F., on tobacco in the vicinity of Chatham, Virginia, the Braconid, *Cardiochiles nigriceps*, Vier., and the Ichneumonid, *Sagaritis provancheri*, D. T. In small collections made in June-August 1943, parasitism by *C. nigriceps* ranged from 78·6 to 95·2 per cent., and that by *S. provancheri* from 15·2 to 43 per cent. Measurements of the head capsules of larvae of *Heliothis* indicated that larvae parasitised by *Sagaritis* usually die in the second or third instar [*cf. R.A.E.*, A **31** 497]. *H. virescens* appears to be the only reported host of *C. nigriceps* [*cf.* **14** 528], but *S. provancheri* has also been recorded from *Laphygma frugiperda*, S. & A., *L. exigua*, Hb., *H. armigera*, Hb., *Vanessa* (*Cynthia*) *atalanta*, L., *Ceramica picta*, Harr., *Pyrausta nubilalis*, Hb., *Hymenia recurvalis*, F. (*fascialis*, Stoll), *Prodenia ornithogalli*, Gn., and *Peridroma saucia*, Hb. (*Lycophotia margaritosa*, Haw.).

Douglass (J. R.), Hallock (H. C.) & Peay (W. E.). **A new Weed Host of the Beet Leafhopper.**—*J. econ. Ent.* **37** no. 5 pp. 714–715, 1 fig., 6 refs. Menasha, Wis., 1944.

Halogeton glomeratus is an introduced weed that was first recorded in the United States in 1937 and is now known to occur in Nevada, Utah and Wyoming. Since it is closely related to the Russian thistle, *Salsola pestifer*, an important summer food-plant of the beet leafhopper, *Eutettix tenellus*, Bak., studies were undertaken in 1943 to determine its suitability as a food-plant for the Jassid. Field and greenhouse tests in summer showed that *E. tenellus* would reproduce on it, and population counts on relatively pure stands of the two plants growing close together in Nevada and Utah showed no significant difference between the numbers of leafhoppers on *Halogeton* and *Salsola*. Preliminary greenhouse experiments showed that *Halogeton* can serve as a reservoir of curly-top virus [*Chlorogenus eutetticola* of Holmes], and if it becomes abundant in the principal breeding areas of *E. tenellus* it may be as important as *Salsola* as a summer food-plant of the leafhopper and summer reservoir of the virus.

MICHELBACHER (A. E.) & BORDEN (A. D.). **Two introduced Insects attacking the Woolly Apple Aphid in California.**—*J. econ. Ent.* **37** no. 5 pp. 715–717, 2 refs. Menasha, Wis., 1944.

Observations in 1942 showed that colonies of the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] in an apple orchard in the Watsonville area of California increased until the end of May, but were then heavily attacked by predators and the parasite, *Aphelinus mali*, Hald., with the result that they were scarce by early July.

The most abundant of the predators, which also included *Chilocorus stigma*, Say (*bivulnerus*, Muls.), was *Exochomus quadripustulatus*, L. This Coccinellid was introduced from Italy and liberated in California in 1915 [*R.A.E.*, A **4** 112] and again in 1927 and 1928 [**17** 718]. It was recovered in 1928 feeding on *Physokermes* (*Kermes*) *insignicola*, Craw, on Monterey pine [*Pinus radiata*] and in 1934 on European sycamore [*Acer pseudoplatanus*] infested by the sycamore scale [*Stomacoccus platani*, Ferris]. It is thought not to have been recorded previously as predacious on *E. lanigerum* in California, and its true importance in this respect is not known. The orchard was not examined in 1943, but in February 1944, Aphid colonies were small and scarce, evidence of predatism was observed, and the Coccinellid was present and probably breeding.

A. mali had been established in the area in 1939 and had become widely distributed by 1942. In surveys in several orchards, the highest percentage parasitism of adult or nearly adult Aphids, excluding those from which parasites had already emerged, was 40–45, but it is thought that the parasite may become more effective when it has reached equilibrium with its environment. Counts in one orchard in February 1944, showed a percentage parasitism of 9·2, as compared with 0·9 on the same date in 1942.

In many orchards, native predators, including Syrphids, Chrysopids and *Coccinella californica*, Mannh., were abundant and controlled the Aphid to a considerable extent.

UPHOLT (W. M.). **The Power of the Analysis of Variance with the Poisson Distribution.**—*J. econ. Ent.* **37** no. 5 p. 717, 1 ref. Menasha, Wis., 1944.

The author shows that a technique formerly employed to analyse data that follow a contagious distribution [*R.A.E.*, A **31** 194] has a much greater power to detect important differences when applied to data that follow a random distribution described by the Poisson law, for which it was designed.

CAMPAU (E. J.) & WILSON (H. F.). **Dispersants for Rotenone. A Study of the Effect of Dispersants on the Toxicity of Rotenone Dusts.**—*Soap* **20** no. 10 pp. 117, 119, 121, 1 graph. New York, N.Y., 1944.

In experiments carried out with dusts of cubé or derris against the pea Aphid [*Macrosiphum onobrychis*, Boy.] in Wisconsin, the success of a treatment was found to depend largely on the carrier used. The chemical qualities of the carrier did not appear important except as the variable quantity of a single combination of elements affected its physical qualities, the chief factor being apparently closely related to particle shape, size and hardness. Differences in particle size, however, were of more importance in different samples of the same material than in samples of different materials. Toxicity increased with increased concentrations of cubé or derris with some carriers and tended to decrease with others. Other insecticides are similarly affected by the material used as carrier; greenhouse tests show that bentonite and some other clays have a definitely depressing effect on pyrethrum and DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane].

In greenhouse tests, derris or cubé dusts containing 0·1, 0·25, 0·5, 0·75 and 1 per cent. rotenone, with or without 2 per cent. oil, in each of 15 different clays, three clay-like materials and " Baggo " (a commercial plant material of unknown source) were applied to plants infested with 20 adult Aphids at the rate of $\frac{1}{2}$ gm. per plant. The percentage control obtained with Pyrax (pyrophyllite) was more than 90 at all concentrations of rotenone when oil was included, but ranged from 27 (0·1 and 0·25 per cent. rotenone) to 88 (1 per cent. rotenone) without oil. With Frianite and with Baggo, dusts containing oil and 0·5–1 per cent. rotenone gave 90 per cent. control or more, but lower concentrations were less effective, and the highest control from dusts without oil (1 per cent. rotenone) were only 72 with Frianite and 68 with Baggo. Ground quartz was found to vary according to the sample ; a white one gave fair results with some concentrations of rotenone when oil was included, but samples having a reddish or blue colour gave relatively poor and inconsistent results. Samples of diatomaceous earth were more variable than quartz, but the degree of control increased with the higher concentrations of cubé or derris. Perry and Cherokee clay gave similar control and were more effective than bentonite and Sheridan clay, which were very poor carriers and seemed to mask the toxic values of rotenone almost completely, regardless of the concentration. A bluish-grey clay was significantly better than a reddish one at all concentrations of rotenone, although they appeared the same under the microscope and had the same range of particle sizes.

From these investigations it is concluded that the effectiveness of rotenone dusts used against *M. onobrychis* is directly correlated with even dispersion and good coverage, and that the best coverage is usually obtained with dusts that give the lightest clouds, settle quickly and are most evenly dispersed on the plants and Aphids. Carriers with large particles (up to 40 microns) gave better coverage and more even dispersion than those in which most of the particles were 2 microns or less in size ; the percentage of the carrier that passed through a 325-mesh sieve and its bulking value gave little indication of the quantity of very fine particles actually present. There seemed to be an inverse relationship between the amount of moisture adsorbed by the carrier and its effectiveness as a dust. The hydrogen-ion concentration of the carriers had no apparent effect on the results obtained with freshly mixed dusts, but there was some indication that differences might develop when dusts were stored. There appeared to be a relation between the magnitude of the electrostatic charge produced by a carrier and its effectiveness ; as a rule, dispersion and coverage, and consequently control, were better for the higher charges [*cf. R.A.E.*, A **29** 569].

Wilson (H. F.), Campau (E. J.) & Janes (R. L.). **The Effect of Plant Dispersants on the Toxicity of Rotenone in ground Cubé when used for Pea Aphid Control.**—*Soap* **20** no. 10 p. 121, 1 graph. New York, N.Y., 1944.

In greenhouse tests against the pea Aphid [*Macrosiphum onobrychis*, Boy.], in which plant materials were used as carriers for cubé, flour, lucerne meal, barley meal and other soft plant tissues did not give satisfactory results, but walnut-shell flour, various samples of lignin and Baggo [see preceding abstract] gave consistently better control than most mineral carriers when applied as dusts containing from 0·1 to 1 per cent. rotenone. It was evident, however, that if lignin was to be used, a complete study of all the different types of lignin would be necessary to ascertain the best. It was particularly noticeable that samples having coarse particles were more effective than those in which the particles were submicroscopic. One type of lignin that gave good control in the greenhouse was as effective as Pyrax (pyrophyllite) in field tests.

A sample of dried blood was also tested and showed fair carrying qualities.

Cory (E. N.), Langford (G. S.) & Chisolm II (J. J.). **Destructive Insects of Vegetable Crops. Their Identification, Habits and Control.**—*Bull. Ext. Serv. Univ. Md* no. 102, [2+] 38 pp., ill. College Park, Md., 1944.

This bulletin contains information on the appearance, habits and control of the principal insects that attack vegetable crops in Maryland. They are arranged according to the food-plant and the type of damage they cause, and most of them are illustrated. Notes on general methods of control, insecticides and spraying and dusting equipment are included.

Shull (W. E.). **Idaho Recommendations for Insect Control.**—*Bull. Idaho agric. Exp. Sta.* no. 252, 63 pp. Moscow, Idaho, 1944.

This bulletin consists chiefly of an annotated list of insects and mites, arranged under their popular names, that are injurious in Idaho. Most of them infest fruit trees, agricultural crops or ornamental plants, but a few that attack stored products or are pests in other ways are included. The notes comprise information on their appearance, habits and control, and a list of common insecticides, with directions for use, and another showing the scientific names of the pests are appended.

Overholser (E. L.), Overley (F. L.) & Allmendinger (D. F.). **Pear Growing and Handling in Washington.**—*Pop. Bull. Wash. agric. Exp. Sta.* no. 174, 84 pp., 21 figs., refs. Pullman, Wash., 1944.

This bulletin includes a section (pp. 65–72) on pests of pear in Washington, prepared by R. L. Webster. *Cydia* (*Carpocapsa*) *pomonella*, L., is common in all pear-growing districts on the Pacific Coast, but causes less damage to pears than to apples. Emergence of adults of the overwintered generation begins about the end of April and generally reaches a peak by mid-May in central Washington. The eggs are deposited on leaves near the blossoms and hatch in about 12 days. The larvae enter the fruits, calyx entry being particularly common on pears, and leave them to pupate after about three weeks. The summer-generation adults emerge in July and August and oviposit on the fruits ; the larvae hatch in 4–7 days and many are still in the fruit at harvest. A lead-arsenate spray is usually applied for control, but cryolite may be substituted ; 2 lb. lead arsenate per 100 U.S. gals. is generally recommended for the calyx spray, but this appears to be much less important for pear than for apple, and is frequently omitted. Two or three cover sprays of 3 lb. lead arsenate per 100 U.S. gals., with a spreader, against the first generation are sufficient throughout the season in many places, but two July sprays may be necessary in concentrated orchard districts. The addition of 0·5 per cent. light or light-medium spray oil as an ovicide to the usual lead-arsenate cover sprays in late May has been particularly effective in checking infestation. Cryolite should be used at the rate of 3 lb. per 100 U.S. gals., with 1 U.S. quart mineral oil as an adhesive or 2 U.S. quarts summer oil when an ovicide is required. Not more than three applications of cryolite should be made during the season, because of the accumulation of fluorine residues. If infestation is heavy, spraying should be supplemented by banding, orchard and packing-shed sanitation and the destruction of infested thinnings.

Pear is sometimes heavily infested by *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., which causes discoloration when it feeds on the fruit. It is controlled by a dormant spray of 10 U.S. gals. liquid lime-sulphur (32° Baumé) or 46 lb. dry lime-sulphur per 100 U.S. gals. or of 4 gals. commercial oil emulsion per 100 gals. spray, which should provide at least 3·2 per cent. actual oil (viscosity 100–120 Saybolt, 50–70 per cent. unsulphonatable

residue). A spray of 3 U.S. gals. liquid lime-sulphur or 12 lb. dry lime-sulphur with 1 U.S. gal. dormant oil emulsion per 100 U.S. gals. spray has given satisfactory results [*cf. R.A.E.*, A **31** 93]. The larvae of the sawflies, *Pristiphora* (*Gymnonychus*) *californica*, Marlatt, and *Caliroa* (*Eriocampoides*) *limacina*, Retz., sometimes damage the leaves of unsprayed pear trees, but are controlled by the lead-arsenate sprays applied against *Cydia*. The adults of *Pristiphora* emerge early in April and deposit eggs in the underside of the leaves ; the larvae hatch in ten days, feed for about a month, and then drop to the ground and spin cocoons among leaves or in the soil within an inch or so of the surface. The larvae of *Caliroa* skeletonise the leaves in June and August ; it has two generations a year and passes the winter in cocoons in the soil.

When temperatures are above normal in late March and early April, adults of the tarnished plant bug, *Lygus oblineatus*, Say, frequently injure the flower buds [*cf.* **20** 25]. They normally feed on the cover crop in the orchard, and it is thought that one of rye may be less conducive to injury than lucerne or sweet clover [*Melilotus*]. The egg punctures of Membracids, of which *Ceresa bubalus*, F., is the commonest, though *C. basalis*, Wlk., and *Stictocephala inermis*, F., are also injurious, cause severe stunting of young trees. The eggs are deposited in slits in one-year-old wood in late summer and autumn, and the nymphs hatch in April or May, drop to the ground to feed on succulent vegetation, particularly lucerne where this is used as a cover crop, and mature in July. Most egg-scars occur less than 6–8 ft. above the ground, and they persist for years, retarding normal growth in recently set trees. Clean cultivation, or the use of a fine-stemmed cover crop such as rye until the trees are 3–4 years old, appears to be the most practical means of control. A dormant spray of oil emulsion in water (4 per cent.) is said to kill a large proportion of the eggs on severely attacked trees if it is thoroughly applied.

Insects discussed more briefly include *Psylla pyricola*, Först. [*cf.* **30** 388] ; *Taeniothrips inconsequens*, Uzel, which has caused little damage in Washington and can be controlled by spraying as the buds open with 2 gals. dormant oil emulsion and 1 pint nicotine sulphate per 100 gals. water or with nicotine sulphate and lime-sulphur if the latter is used for scab control ; and the larvae of *Graptolitha* spp., which feed on the young fruit, but are seldom injurious where lead-arsenate cover sprays are applied.

The mites that attack pear in Washington are, in order of importance, *Eriophyes pyri*, Pgst., *Phyllocoptes schlechtendali*, Nal., *Paratetranychus pilosus*, C. & F., *Tetranychus pacificus*, McG.; and *T. willamettei*, McG. *E. pyri* overwinters under the bud scales and attacks the unfolding leaves in spring, sometimes causing complete defoliation of unsprayed trees, especially in non-irrigated areas. It is rarely injurious where lime-sulphur is applied regularly in the dormant or delayed-dormant spray [*cf.* **31** 93] ; dormant oil sprays are less effective. *Phyllocoptes schlechtendali* causes curling of the leaves and, in severe cases, russeting of the fruit. The mites overwinter under the bud scales, become active when the buds swell in early April and move to the leaves, on which they feed and reproduce during spring and summer ; they return to the bud scales during August or September. They are usually controlled by dormant or delayed-dormant applications of lime-sulphur, but may become sufficiently abundant in July to require special applications of sulphur, dilute lime-sulphur or summer oils. *Paratetranychus pilosus*, which overwinters in the egg stage on branches and twigs, and occasionally attacks pear foliage, can be controlled by dormant sprays of 4 per cent. commercial oil emulsion, or, if necessary, by two applications of light-medium oil emulsion (1 per cent. actual oil) at an interval of 8–10 days in summer. Adult females of *T. pacificus* overwinter under débris on the soil or in cracks in the soil or on the tree. The mites are sometimes conspicuous in early spring, when they crawl up the trunk and branches to the new foliage ; if infestation is serious, a spray of dilute lime-sulphur may be applied, provided that it does not interfere with later use of oil against *Cydia*

pomonella. Summer infestations can be controlled by one or two applications of oil sprays [*cf. loc. cit.*]. Downward migration begins in July, and spraying after this time is of questionable value. *T. willamettei* is said to web the foliage to a less extent than *T. pacificus*; it can be controlled by sprays of dilute lime-sulphur, sulphur or summer oil.

Service and Regulatory Announcements, October-December 1944.—*S.R.A., B.E.P.Q.* no. 161 pp. 75–116. Washington, D.C., U.S. Dep. Agric., 1945.

Since comparable infestations of cotton by *Platyedra* (*Pectinophora*) *gossypiella*, Saund., exist on both sides of the lower Rio Grande, a revision of Foreign Quarantine no. 8 against the introduction of this Pyralid into the United States authorises the importation under permit into four border counties of Texas of cottonseed produced and sterilised in specified portions of the State of Tamaulipas, Mexico, for milling and handling under the conditions that apply within the counties named. The importation of cottonseed hulls produced from seed originating in the same area of Mexico is also authorised, provided that the seed is sterilised during the ginning process and subsequently protected from infestation. The area of the Imperial Valley, Mexico, from which cottonseed and cottonseed hulls may be imported into the United States under permit is extended to include not only that part of the valley that lies in Lower California but also a small adjacent area in north-western Sonora. Their importation from any other foreign country or locality is still prohibited.

The domestic quarantine (Quarantine no. 52) against *P. gossypiella* is also revised. Its provisions include authorisation of the movement under permit of cottonseed produced in lightly infested areas of the United States to other areas provided that it has been heated to 150°F. and kept at this temperature for at least 30 seconds as part of the continuous process of ginning and subsequently protected from infestation. Cottonseed produced in a heavily infested area may be moved into adjacent lightly-infested areas provided that it has been subjected to the treatment described and is subsequently heated to and kept at a temperature of 155°F. for at least 60 seconds, in a separate plant or on arrival at a designated oil mill. Both heat treatments are to be carried out under supervision.

Other information in this part includes supplements to plant-quarantine restrictions already noticed in Southern Rhodesia and Peru.

Bramble (W. C.) & Holst (E. C.). **Fungi associated with *Dendroctonus frontalis* in killing Shortleaf Pines and their Effect on Conduction.**—*Phytopathology* **30** no. 11 pp. 881–899, 5 figs., 11 refs. Lancaster, Pa., 1940. [Recd. 1945.]

A detailed account is given of investigations carried out in 1932, 1934 and 1935 in North Carolina on the relative importance of various fungi associated with the bark-beetle, *Dendroctonus frontalis*, Zimm., on *Pinus echinata*. It was observed that attack by the beetle was followed by infestation by numerous fungi, a list of which is given. A few of them played an active part in killing the trees and were constantly present in trees infested by the beetle, penetrating into the sapwood and stopping water conduction. The most active and important of these fungi was *Ceratostomella pini* [*cf. R.A.E.*, A **23** 512, etc.]; it was not the most prominent in the earliest stage of infestation, but was the only one capable of penetrating to the centre of inoculated stems of healthy trees. Secondary invading fungi, which appeared only when the needles were turning yellow, were not of importance in connection with the death of the tree. The chief effect of the fungi accompanying beetle attack was to bring about the death of the trees more rapidly than would be the case as the result of beetle attack alone.

Craighead (F. C.) & St. George (R. A.). **Field Observations on the Dying of Pines infected with the Blue-stain Fungus,** *Ceratostomella pini* **Münch.**—*Phytopathology* **30** no. 11 pp. 976–979. Lancaster, Pa., 1940. [Recd. 1945.]

In connection with the work noticed in the preceding abstract, the authors record field observations made in Virginia in 1934, at the close of an outbreak of *Dendroctonus frontalis*, Zimm., on short leaf pine [*Pinus echinata*]. During the preceding summer and autumn many trees were attacked by the beetles, but the latter were killed by the increased flow of resin and few reached the xylem. As a rule, trees attacked by *D. frontalis* die rapidly as a result of penetration by *Ceratostomella pini* and the rapid drying accompanying destruction of the phloem. The foliage begins to fade after about three weeks. Trees in which few beetles reached the xylem, however, did not fade until the following spring, as the amount of fungus that developed from the reduced number of beetle contacts was insufficient to cut off conduction quickly. The fungus was found in the parts of the trees attacked by the beetle even though little brood developed. The relation between the development of beetle attack and that of the fungus is shown in a table.

Leech (H. B.). **The Cerambycid Beetle,** *Phymatodes dimidiatus*, **in Cedar structural Timbers.**—*Canad. Ent.* **76** no. 10 p. 211. Guelph, Ont., 1944.

Adults of *Phymatodes dimidiatus*, Kby., emerged in numbers from wooden uprights 4 × 6 ins. in section in a house in British Columbia in late April 1943. The uprights were of cedar (*Thuja plicata*), and it is assumed that they were infested before being placed in position [*cf. R.A.E.*, A **19** 438]. On leaving the timber, the beetles passed first through a layer of tarred building paper and then through either cedar shingles or a layer of gypsum wall-board, $\frac{1}{2}$ inch in thickness, according to whether they emerged on the outside or the inside of the house.

Hayward (K. J.). **Primera lista de insectos tucumanos perjudiciales. Primer suplemento.** [First List of Tucumán Insect Pests. First Supplement.]—*Publ. misc. Estac. exp. agríc. Tucumán* no. 4, 32 pp. Tucumán, 1944.

The general arrangement of this supplement is the same as that of the original list [*R.A.E.*, A **31** 477], but it is divided into two parts. Additional food-plants for species that were included in the original list are recorded in the first and a further 183 insects of economic importance in Tucumán in the second. Indices to the insects and the food-plants are again appended.

Monte (O.). **Curculionídeos do tomateiro.** [Weevils that attack Tomato.]—*Biológico* **10** no. 4 pp. 103–108, 5 figs. São Paulo, 1944.

Brief notes are given on the bionomics and control of four weevils injurious to tomato in Brazil, together with descriptions of the adults and statements of their distribution. All the aerial parts of the plants are attacked by *Phyrdenus divergens*, Germ. [*cf. R.A.E.*, A **13** 198; **17** 45], which also infests potato in one area and solanaceous weeds. The eggs are laid in masses of about six and enclosed in a case, composed of hairs from the plant, that is affixed to the stem at the base of a peduncle or to a leaf. The larval stage lasts about a month, and the pupal stage, which is passed in the soil, 15–20 days. The methods of control suggested are hand collection of the adults, spraying with an insecticide such as Paris green, soil cultivation to expose the pupae, and the destruction of alternative food-plants. *P. muriceus*, Germ., which infests egg-plant [*Solanum melongena*] in the United States [*cf.* **18** 375] and tomato, potato and *S. melongena* in Argentina [*cf.* **13** 440], has recently been observed on

tomato in the State of Espirito Santo, causing wilting and sometimes the death of the plants. This weevil lives in the soil, and the larvae feed on the roots and the main stem, preferring the former. The control measures recommended are early planting, to allow the plants to develop before the attack begins, rotation of crops, the prevention of excessive humidity, which favours the weevil, the destruction of any alternative food-plants, and ploughing immediately after harvest to expose the larvae and pupae.

Faustinus (*Collabismodes*) *cubae*, Boh., of which *F.* (*C.*) *tabaci*, Mshl., and *F.* (*Euxenus*) *variegatus*, Hust., are stated in a footnote to be synonyms, attacks tomato, potato, tobacco, *Solanum gilo*, pimento (*Capsicum annuum*) and other solanaceous plants. It is commonest on *C. annuum*. The larvae bore in the shoots, even after the plant has died, and pupate in cells at the junction of two shoots. The larval stage lasts about three months. The author quotes a statement from Bondar to the effect that *F. cubae* has caused considerable losses of tomato in the State of Bahia. The only control measures available are the destruction of infested plants and of all alternative food-plants of the weevil. *F. apicalis*, Faust, which attacks tomato, tobacco and *S. gilo*, has similar habits.

Lepage (H. S.) & Giannotti (O.). **D.D.T. (Dicloro-difenil-tricloroetana).**—*Biológico* **10** no. 8 pp. 239–252, 4½ pp. refs. São Paulo, 1944.

The authors review the results of outstanding experiments on the use of 2,2-bis (parachlorphenyl)-1, 1,1-trichlorethane (DDT) as an insecticide in the United States [*R.A.E.*, A **32** 375, 377, 378], and of tests in Switzerland by Wiesmann in which soil treatment with an emulsifiable preparation of DDT known as Gesapon was effective against the carrot fly [*Psila rosae*, F.] and the cabbage fly [*Hylemyia brassicae*, Bch.], and give an account of their own work in São Paulo, Brazil, with three preparations of DDT (Gesarol) containing 5, 3 and 40 per cent. active ingredient, respectively. The first was used in sprays only, and the second in dusts.

In tests of contact action, the percentage mortality of fourth-instar larvae of *Bombyx mori*, L., sprayed with 1, 0·5 and 0·25 per cent. suspensions of Gesarol (5 per cent.) were 74, 64 and 33·3 after 48 hours and 100, 94·1 and 40 after 96 hours, and the symptoms observed suggested that the material acts on the nervous system. When 0·1 gm. Gesarol (3 per cent.) was mixed with lots of 100 gm. barley heavily infested with *Calandra* (*Sitophilus*) *oryzae*, L., and the barley was kept in closed petri dishes, the percentage mortality was 60 after 48 hours and 91·3 after 72, and when three lots of 200 gm. infested maize were mixed with 0·1 gm. Gesarol and kept in similar dishes, one of which was covered only with cloth, so that circulation of the air was not impeded, there was little difference in effectiveness between the treatments, mortality being complete in the cloth-covered dish and one of the others in 125 hours and in the remaining dish in 130 hours. Good results were also given by spraying soldiers of the ant, *Atta laevigata*, F.Sm., with a 1 per cent. suspension of Gesarol (5 per cent.) or dusting them, and ants placed on filter paper that had been moistened with the spray and allowed to dry all died in 60 hours. When examples of *Bravicoryne brassicae*, L., were sprayed on filter paper, the percentage mortalities in 48 hours were 49·8 and 35·9 for 1 and 0·5 per cent. suspensions of Gesarol (5 per cent.) and 87·6 and 66·4 for 0·5 and 0·25 per cent. suspensions of the concentrate (40 per cent.). The percentage mortalities of Aphids dusted with Gesarol (3 per cent.) were 33, 65, 95 and 100 in 24, 48, 70 and 90 hours, respectively. In tests on *Macrosiphum solanifolii*, Ashm., on potato plants, the Aphids were sprayed with 1, 0·5, 0·25 and 0·125 per cent. suspensions of Gesarol (5 per cent.), and the percentage mortalities in the two series 48 hours later were 93, 61, 39 and 28, respectively, in one series and 92, 69, 49 and 16 in another.

Tests were also made on the value of DDT as a stomach poison. In some against *Epicauta atomaria*, Germ., potato plants were sprayed with 0·14 and 0·4 per cent. suspensions of Gesarol (5 per cent.) and the same concentrations of lead arsenate, and examples of the Meloid were confined on them. The percentage mortalities were 33·3 and 53·3 after 48 hours and 40 and 93·3 after 72 hours for the two concentrations of Gesarol, respectively, and 0 and 6·6 after 72 hours for lead arsenate. Fourth-instar larvae of *Bombyx mori* were not affected by feeding on sandwiches made of pieces of mulberry leaf 38·5 sq. mm. in area that had been dusted by means of special apparatus with Gesarol (3 per cent.) so that each sandwich contained 0·0331 mg., but when the test was repeated with 26 larvae using the concentrate (40 per cent.), so that each sandwich contained 0·0346 mg., the ten that ingested more than half the dose died within 18 hours, and the others, which ate less than half, in 48 hours. Cotton leaves sprayed with a 1 per cent. suspension of Gesarol (5 per cent.) and allowed to dry repelled larvae of *Alabama argillacea*, Hb., and those that ate sandwiches containing very small amounts of the dust in a preliminary test appeared unaffected. Larvae of *Ascia* (*Pieris*) *monuste*, L., were very susceptible, however, and died within 48 hours of eating only a quarter of a sandwich.

Bates (M.). **Insectos nocivos.** [Harmful Insects.]—*Rev. Fac. nac. Agron.* (*Colombia*) **5** no. 18 pp. 333–401 ; no. 19 pp. 553–573. Medellín, 1942. **Las plantas cultivadas y sus plagas. Lista alfabetica.** [Cultivated Plants and their Pests. Alphabetical List.]—*T.c.* pp. 574–593. [Recd. 1945.]

In the first of these papers, the author discusses in an introductory section the development and classification of insects, the damage that some of them cause to plants, and methods of controlling them, including the use of various common insecticides and of parasites, and gives an annotated list of insects that attack crops and stored seeds in various countries of Central America, with special reference to Guatemala. The pests are arranged systematically, and the notes include information on the crops attacked, morphology, life-history, natural enemies and control measures.

The second paper is an alphabetical list of cultivated plants under their scientific and vernacular names, showing the insects that attack them in Guatemala and other Central American countries.

[Waterston (J.M.).] **Plant Pathology.**—*Rep. Dep. Agric. Bermuda 1943* pp. 7–8. [Hamilton] 1944.

In the course of work in Bermuda in 1943, the so-called blight of Bermuda cedar (*Juniperus bermudiana*) [*cf. R.A.E.*, A **26** 220] was found to be due to insect damage, the two pests of importance being the Flatid, *Ormenis infuscata*, Stål, and a Cecidomyiid close to *Contarinia juniperina*, Felt [**28** 67]. The Flatid was abundant on affected foliage in May. Young shoots are quickly killed by it, and it is possible that it injects a toxic substance while feeding. Injury is most severe in dry seasons on trees growing on shallow soil ; small trees may be completely defoliated and their branches appear as if scorched. Vigorous trees recover, but overcrowded and badly-nourished ones sometimes die. The complete life-history of *O. infuscata* is not known ; the eggs are deposited in plant tissue and covered by a waxy secretion, and the nymphs moult five times. *Chrysopa* sp. is predacious on the young nymphs. The larvae of *Contarinia* hatch from eggs laid in the leaf-scales and kill the young twigs by boring into them at the base of the needles. The trees are also damaged, though apparently not seriously, by an Aphid of the genus *Cinara* (*Neochmosis*) which feeds in the crutch of small branches and on the leaves. As a result the leaves gradually turn yellow and the trees are eventually defoliated ; this

injury resembles that due to *Chrysomphalus agavis*, Tns. & Ckll. The Aphid is normally controlled by the Syrphids, *Allograpta obliqua*, Say, and *Mesogramma marginata*, Say. The only measures at present available are those that promote the general vigour of the trees, such as pruning and thinning. These have been shown to be effective and are of especial value on shallow soil.

Other insects recorded are *Aleurodicus* (*Metaleurodicus*) *cardini*, Back, on sweet orange (*Citrus sinensis*) and *Citharexylum spinosum*, and *Xylocopa virginica*, Drury, living examples of which were found in lumber imported from North America. Two entomogenous fungi, *Entomophthora* (*Delacroixia*) *coronata* and *Mucor hiemalis* were also observed ; the former occurred on leaves of *J. bermudiana*, but was found to destroy the dry-wood termite, *Kalotermes approximatus*, Snyder, under moist conditions, and the latter occurred on a dead adult of *K. approximatus*.

WILLIAMS (F. X.). **A Survey of Insect Pests of New Caledonia.**—*Hawaii. Plant. Rec.* **48** no. 2 pp. 93–124, 37 figs. Honolulu, 1944.

In view of the rapid development of transport, particularly by air, and the consequent risk of accidental introductions of insect pests into Hawaii, a survey of the insects attacking agricultural crops in New Caledonia was carried out in July–November 1940 to provide information on which to base protective measures. The results, supplemented by previous records, are given in the form of an annotated list of insects arranged under their food-plants and showing those that are not known to occur in Hawaii ; notes on some forest pests and insects that attack noxious weeds are included. The paper also contains a short account of the physical geography, vegetation, fauna and agriculture of the Island.

LEVER (R. J. A. W.). **Division of Entomology. Annual Report for the Year 1943.**—*Agric. J. Fiji* **15** no. 3 pp. 73–75. Suva, 1944.

Some of the information in this report on insect pests in Fiji in 1943 has already been noticed [*R.A.E.*, A **33** 161]. Those of importance recorded in the field during the year included *Plutella maculipennis*, Curt., on cabbage and turnip; *Crocidolomia binotalis*, Zell., on cabbage and radish ; *Margaronia indica*, Saund., on pumpkin ; *Maruca testulalis*, Geyer, *Zizera labradus mangoensis*, Btlr., and *Nezara viridula* var. *smaragdula*, F., on beans ; *Epilachna vigintioctopunctata*, F., on potato, cabbage and egg-plant [*Solanum melongena*] ; *Cylas formicarius*, F., on sweet potato ; *Sogata furcifera*, Horv., on rice ; *Mictis profana*, F., on orange ; and *Adoretus versutus*, Har., and *Aulacaspis cinnamomi*, Newst., on rose. An adult male of *Pieris rapae*, L., was taken in flight near Suva wharf. Insects observed infesting stored products were *Lasioderma serricorne*, F., which attacked dried chopped cabbage and beans, *Calandra oryzae*, L., in wheat, and *Bruchus obtectus*, Say, in bean seeds imported from New South Wales. *Catorama herbarium*, Gorh., attacked book covers [*cf.* **32** 167] and leather suit-cases.

Native parasites reared from insect pests during the year were *Hemiptarsenus semialbiclavus*, Gir., from larvae of *Phytomyza spicata*, Mall., on maize leaves ; *Eucoila* sp. from larvae of *Agromyza* (*Liriomyza*) *strigata*, Mg., on sweet-potato leaves ; *Diplazon laetatorius*, F., from *Syrphus corollae* var. *vitiensis*, Bez., which is predacious on *Rhopalosiphum nymphaeae*, L., on water hyacinth [*Eichhornia*] and the stalks of rice ; *Apanteles expulsus*, Turn., and *Mesochorus* sp. from larvae of *Plusia chalcites*, Esp. ; an unidentified species of *Apanteles* and another of *Chelonus* (*Chelonella*) from larvae of *Crocidolomia binotalis* ; and a Braconid closely related to *Opius tryoni*, Cam. [*cf.* **33** 161] from *Dacus* (*Notodacus*) *xanthodes*, Broun.

Mass rearing of *Microphanurus basalis*, Woll., the egg parasite of *Nezara viridula smaragdula*, could not be begun until June owing to the absence of host eggs, but a total of 11,880 was released in six months and a further consignment was sent to New Caledonia. *Thyraeella* (*Diadromus*) *collaris*, Grav., which parasitises the larvae and pupae of *Plutella maculipennis*, was introduced from New Zealand and released in Fiji [*cf.* **32** 167], and a small consignment was forwarded to Tonga. The species of *Dirhinus* that was introduced [against *Dacus* spp.] in 1937 [**26** 59] has not been recovered, and mass rearing of this Chalcid was discontinued at the end of July ; 20,150 adults of *Syntomosphyrum* (*Melittobia*) *indicum*, Silv. [**31** 233, 361] were released against fruit-flies during the year. Consignments of *Teleonemia scrupulosa*, Stål, were sent to two localities on Viti Levu against the noxious weed, *Lantana*, which it does not control well in the wet zone.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **15** no. 3 pp. 76–80, 17 refs. Suva, 1944.

Additions to the list of food-plants of *Nezara viridula* var. *smaragdula*, F., in Fiji made since 1941 [*R.A.E.*, A **29** 170, 279 ; **31** 232] comprise the pods of *Crotalaria mucronata*, which are also attacked by this Pentatomid in Montserrat, the leaves of cabbage and beet, tobacco stems, *Capsicum* and the vines of sweet potato. Development of the egg parasite, *Microphanurus basalis*, Woll., in 1941–43 lasted 14–14½ days in July and 8½ in March, when the temperatures ranged from 72·8 to 73·9°F. and from 80·4 to 81·8°F., respectively. In experiments in October 1943 to determine the effect of retarding development by holding parasitised egg clusters at temperatures of about 46–52°F. for 12 days, only six of a total of 80 parasites emerged and development lasted 24 days; it is thought that fair survival could be obtained if the parasites were kept at a rather higher temperature for less than a week.

The author points out that the record of *Apanteles ruficrus*, Hal. (*antipoda* Ashm.) given in a previous paper [**30** 158] should refer to *A. expulsus*, Turn

WEDDELL (J. A.). **Fruit-sucking Moths.**—*Qd agric. J.* **59** pt. 2 pp. 89–92, 3 figs. Brisbane, 1944.

In Queensland, adults of *Othreis* (*Ophideres*) *fullonia*, Cl. (*fullonica*, L.), *O.* (*O.*) *materna*, L., and *Eumaenas* (*O.*) *salaminia*, Cram., cause considerable damage by piercing the skin of ripening fruits and sucking the juice. Injury is commonest in coastal areas, although outbreaks are occasionally recorded from inland districts. The greatest losses occur in *Citrus*, other than lemons, but many other fruits are also damaged. Green fruits of early varieties of *Citrus* are sometimes attacked if the moths are abundant and there is little alternative feeding material. The feeding punctures permit the entry of rots, resulting in the decay of the fruit, and of adults of *Carpophilus hemipterus*, L., which oviposit in the fermenting tissues inside ; the larvae of this Nitidulid burrow through the fruit.

O. fullonia, of which the larva, pupa and adults are described, oviposits in spring on the foliage of menispermaceous vines [*cf. R.A.E.*, A **28** 591], which are common in coastal rain forests, along creek banks and sometimes in open forest country, and the larvae feed on the leaves of these for about three weeks and pupate in shelters of adjacent leaves webbed together. The moths emerge about three weeks later. They are strong flyers and are found in inland orchards far from areas in which their larval food-plants are known to grow. They normally shelter by day in timbered country near the orchard, which is visited each night from dusk onwards. They occur from November until May in southern Queensland and for longer in the more northerly areas. The population

is increased by heavy rainfall in early spring, which encourages the growth of the food-plants, and decreased by Hymenopterous parasites that attack the larvae.

No altogether satisfactory method of control is known. Fruit trees should be examined each evening with the aid of a torch or lamp, particularly if the fruits are ripening, and moths feeding on the fruits should be destroyed. Bunches of ripe or over-ripe bananas can be hung in the trees as baits, and fallen, prematurely ripened fruit can be used in the same way or piled on the ground, though fruit that shows evidence of infestation by fruit-flies should not be used. All fruit baits should be examined for moths every night and destroyed every three days, as a precaution against fruit-fly infestation. If open-mouthed hessian bags are suspended upside down with the fruit bait in the mouth, the moths tend to move upwards into them at dawn and can be killed early each morning.

STUBBS (L. L.) & GRIEVE (B. J.). **A new Virus Disease of Carrots.**—*J. Dep. Agric. Vict.* **42** pt. 9 pp. 411–412, 415, 6 figs., 2 refs. Melbourne, 1944.

Investigations were begun in 1941 on a virus disease of carrots, believed to be new, that has recently been observed in market-garden areas in Melbourne and in newly-developed carrot-growing areas in south-eastern and western Victoria. The symptoms bear a superficial resemblance to those caused by mineral deficiency and are described for plants at three stages of growth. Plants that become infected while young do not produce marketable roots, and the inner leaves of those that are infected when nearly mature take on the appearance of a bunched rosette, surrounded by the large leaves formed before the plants became infected.

In controlled experiments with Aphids and Jassids found feeding on diseased plants, an Aphid tentatively identified as *Cavariella aegopodii*, Scop., which is common on carrots, consistently transmitted the disease from infected plants in the field to healthy plants in insect-proof cages. When the Aphids were transferred from infected carrot to *Salix vitellina*, which is a common food-plant of *C. aegopodii*, and reared on it for several generations, no disease symptoms developed, either on the willow or on healthy carrot plants to which the progeny were subsequently transferred. Healthy carrot plants infected by Aphids reared on healthy carrot or willow and subsequently allowed to feed on diseased carrot developed typical symptoms after a minimum of 14 and an average of 17 days. Attempts to transmit the disease mechanically or by means of Jassids were unsuccessful.

Observations at several places in 1943 showed a close relationship between the appearance of *C. aegopodii* on carrots in the field and that of symptoms. In one of them, the Aphid appeared in numbers in October and persisted until the second week of December. In varietal trials, the usual commercial varieties were susceptible, but two others were highly resistant.

The symptoms caused by this virus bear some resemblance to those of western celery mosaic [*Marmor umbelliferarum* of Holmes] in carrots [*R.A.E.*, A **27** 590], but the latter can be transmitted mechanically. They also somewhat resemble those of aster yellows in carrot as described by Severin [**21** 168] for the Californian strain [*Chlorogenus callistephi* var. *californicus* of Holmes], but this disease is transmitted by a Jassid and, as it infects a wide range of plants, is unlikely to have escaped notice if it were present in Australia.

MILLER (L. W.). **Investigations of the Flour Beetles of the Genus *Tribolium*. III. A colour Strain of *T. castaneum* (Hbst.).**—*J. Dep. Agric. Vict.* **42** pt. 10 pp. 469–471, 5 refs. Melbourne, 1944.

In the course of a survey made to determine the species of *Tribolium* present in bulk wheat in Victoria [*cf. R.A.E.*, A **33** 129], a previously unrecorded

colour strain of *T. castaneum*, Hbst., was found in 1943. The adults were brownish-black to black instead of reddish-brown, and the larvae were also darker than those of the normal strain. Crosses between the strains showed that the colour of the adults of *T. castaneum* is apparently due to a single genetic factor. In experiments, the larvae of the normal strain developed more rapidly than those of the new one on a highly nutritive diet, but less rapidly on one of low nutritive value, possibly because they were more sensitive to a deficiency of B-group vitamins [*cf.* **33** 235].

STOFBERG (F. J.). **The Control of Cabbage Pests.**—*Fmg in S. Afr.* 1944 repr. no. 56, 3 pp. Pretoria, 1944.

Notes are given on the control of several insects that infest cabbage in South Africa. The bagrada bug [*Bagrada hilaris*, Burm.] chiefly attacks seedlings, which it frequently destroys, but it also damages weak plants after transplanting. This Pentatomid can be controlled by a spray prepared by dissolving 1 lb. soap in 1 gal. boiling water, stirring in 1 pint crude carbolic acid, boiling for 30 minutes, and diluting with 15 parts water, or one prepared by dissolving 1 lb. soap in 2½ gals. water and, immediately before use, stirring in 1 pint 60 per cent. commercial methylated spirit. Seedlings can be protected by placing frames covered with gauze over the beds or by surrounding the beds with a screen of fine wire gauze 3 ft. high, which apparently excludes the bugs.

Larvae of *Plutella maculipennis*, Curt., and *Crocidolomia binotalis*, Zell., also cause heavy losses. On the high veldt, where injury is less serious, sufficient protection against both species is afforded by dipping the seedlings in a suspension of lead arsenate [*cf. R.A.E.*, A **32** 432], but on the low veldt, where *P. maculipennis* is seldom controlled by parasites, the plants should be dusted two or three times at a rate of about 30 lb. per acre with a mixture of lead arsenate or calcium arsenate and talc (1 : 3–4) or cryolite and talc (1 : 1). Applications should not be made within five weeks of harvesting.

Aphids on cabbage can be controlled by proprietary dusts containing 2 or 4 per cent. nicotine or sprays of nicotine sulphate (1 : 800) or 7 per cent. nicotine extract (1 : 100), preferably with the addition of 1 lb. soap per 20 gals. spray. A home-made nicotine spray can be prepared by steeping 1 lb. scrap tobacco, preferably of the snuff (Virginia) type, cut into ½-inch lengths, in 1 gal. hot (not boiling) water for 24–48 hours until the liquid is the colour of strong tea, and straining. It should be used immediately and without further dilution.

BARNES (H. F.) & WEIL (J. W.). **Studies of Fluctuations in Insect Populations. XI. The Interrelationship of the Wheat Blossom Midges and their Host Plant.**—*Ann. appl. Biol.* **31** no. 3 pp. 231–234, 2 graphs, 2 refs. London, 1944.

Consideration of data obtained at Harpenden in an insectary and in a field of permanent wheat over the period 1929–43 and in wheat trials in 1933–39 confirmed previous findings of a correlation between the dates of emergence of the ears and that of *Contarinia tritici*, Kby., and between these and the harvesting dates [*R.A.E.*, A **30** 91]. It was also apparent that observations on the emergence of *C. tritici* in an insectary, even one at some distance from the growing wheat, give as reliable an indication of the forwardness of the crop as field observations. Further data show the percentages of grain attacked by *C. tritici* and *Sitodiplosis mosellana*, Géh., and the yields of wheat in the permanent field for the years 1927–43, together with the average yields for the whole of Great Britain for the years 1927–38 and the estimated yields for each year. These were based on the apparent inverse relation between yields in the permanent field and the percentage of grain infested there in early July. This correlation was only doubtfully significant statistically, and infestation was

more closely correlated with the average yields for Great Britain ; nevertheless, the estimated yields were in most cases close to those actually obtained. The estimates were more accurate for the whole country, either because midge populations are influenced more by major differences in weather, etc., from year to year than by local variations, or because the development of the wheat in the permanent field is largely influenced by such local variations. The suitability of the permanent field for measuring fluctuations in midge populations is attributed partly to the absence of disturbance by crop rotation and to the fact that populations are sufficiently established there to have reached a state of equilibrium with their natural enemies.

EVANS (A. C.). **Observations on the Biology and Physiology of Wireworms of the Genus *Agriotes* Esch.**—*Ann. appl. Biol.* **31** no. 3 pp. 235–250, 10 graphs, 16 refs. London, 1944.

The investigations described were carried out in southern England in 1941–44, and the species concerned, where known, were *Agriotes obscurus*, L., *A. lineatus*, L., and *A. sputator*, L. The following is based largely on the author's summary. Detailed studies of the growth of wireworms kept at a constant temperature of 15°C. [59°F.] for three years and at natural soil temperatures for two years are presented. It is shown that small wireworms grow rapidly and moult frequently, while large ones grow slowly or remain constant in weight and moult infrequently. A basic pattern, based primarily on a five-year life cycle, is suggested to explain the decreasing frequency of moulting in the larvae of *A. obscurus*. The feeding activity and moulting frequency of a population of wireworms was studied in detail throughout the season, and definite peaks in both were observed. It was found that such activity could be satisfactorily analysed by dividing the population into groups on a basis of the number of annual moults . Increase in dry weight was a more valid estimate of growth than increase in fresh weight. The rate of growth of wireworms was strongly influenced by the plants on which they fed. Some plants (wheat and carrots) permit rapid growth. Others (grass and clover) permit slower growth, and a third group (mustard and potatoes) merely the maintenance of weight. Wireworms reared on flax actually decreased in dry weight.

It was found in a field experiment that the type of crop grown after breaking up old pasture had a distinct effect on the wireworm damage done to the following cereal crop. Beans had the effect of reducing the population to a level at which a very successful crop was grown. Better yields were obtained after grass or wheat than after beet, barley, flax, potatoes or oats, at similar levels of population.

The cuticle of wireworms is permeable to water [*cf. R.A.E.*, A **31** 26], and it is shown that in its relations to soil moisture the wireworm can be regarded as an osmotic system. The pF scale of soil moisture is shown to be of value in expressing the soil-moisture relations of wireworms [**32** 333]. Wireworms feed more actively in moist than in dry or wet soil.

GADD (C. H.). **A further Note on an unusual Correlation between Insect Damage and Crop harvested.**—*Ann. appl. Biol.* **31** no. 3 pp. 250–254, 1 graph, 4 refs. London, 1944.

Observations on the damage caused to tea in Ceylon by *Xyleborus fornicatus fornicatior*, Egg., in relation to pruning and manuring [*cf. R.A.E.*, A **32** 305] were continued in 1943, the last year of a three-year pruning cycle. The reduction in infestation observed in earlier studies to occur in the third year [**30** 509 ; **31** 296], as indicated by the numbers of broken branches, again took place, and the positive correlation between the number of breakages and yield noted in the previous year [**32** 306] was again evident. The yield from

manured plots was significantly higher than that from unmanured plots during 1943 [*cf.* **32** 306], but not over the whole cycle; the use of manures produced no statistically significant effect on the number of broken branches.

Previous evidence had suggested that the number of broken branches depends more on the number of galleries than on a change in the fragility of the branches, but in 1943 the correlation between the numbers of broken branches and galleries per broken branch was even less than in the previous year, when it had not been significant. When the bushes were pruned at the end of the year, the number of branches cut from samples comprising seven bushes from each plot and the number of galleries per sample were counted, and a high correlation was found to exist between them. There was no significant correlation between either yield or number of broken branches over the whole cycle and number of pruned branches, which indicates that the relationship between yield and insect damage does not depend upon the size of the bushes, if this is adequately measured by the number of pruned branches. The correlation between the total number of galleries in each sample and the number of broken branches collected during the cycle was not significant, but a significant correlation was obtained when the number of galleries was expressed as the number per pruned branch. From a further analysis of the latter relationship, it is concluded that the number of broken branches is largely dependent on the number of galleries. Various methods of measuring beetle infestation are discussed, and the author concludes that one based on the number of broken branches is the most reliable.

These studies show that manurial treatments that improve yield also increase liability to attack by *X. fornicatus fornicatior* and the amount of damage due to it, thus reducing the benefits obtained. In view of the absence of important natural enemies of the borer and the small extent to which migration takes place, the observed occurrence of a marked increase and decrease in infestation within a period as short as the pruning cycle is surprising. The author considers that a small population remains in the bush after the main part has been destroyed with the prunings and is able to maintain itself until conditions favouring a rapid increase arise. In view of the influence of different types of plucking on the rate of increase of population [**31** 296], it is probable that manurial treatments can also influence it through changes in the internal condition of the bushes, probably by affecting the rate of growth of the ambrosia fungus on which the beetle feeds.

Bovingdon (H. H. S.) & Coyne (F. P.). **Trichloracetonitrile as a Fumigant.**—*Ann. appl. Biol.* **31** no. 3 pp. 255–259, 4 refs. London, 1944.

An account is given of experiments on the value of trichloracetonitrile as a fumigant against insect pests, largely those infesting stored products. In laboratory tests in which *Calandra granaria*, L., *Tribolium castaneum*, Hbst., and larvae of *Ephestia kuehniella*, Zell., in muslin bags were exposed to the vapour for five hours at 20°C. [68°F.] and the results determined a week later, complete mortality was given by minimum concentrations of 22·2, 15·7 and 5·8 mg. per litre [equivalent to oz. per 1,000 cu. ft.], respectively; a concentration of 1·2 mg. per litre was not toxic, and mortality among the controls averaged 0, 1 and 10 per cent. The concentrations of ethylene oxide required to give 50 and (in brackets) 99 per cent. mortality were estimated to be 6·7 (13·3), 10·6 (35·4) and 5·4 (19·1) mg. per litre, respectively, and those of hydrocyanic acid gas 10·2 (28·3), 0·19 (0·54) and 0·13 (0·33) mg. In similar experiments with *C. granaria* and seven other pests of stored products, only larvae of *Trogoderma versicolor*, Creutz., were more resistant than *C. granaria*, but 30 per cent. of the latter survived exposure to a concentration of 25 mg. per litre. The penetrative capacity of trichloracetonitrile was compared with that of ethylene oxide in an experiment in which lots of 480 lb. wheat were fumigated in a cylindrical bin about 2½ ft. in diameter and 3 ft. deep, which they filled to a height of about 2 ft., at varying grain temperatures and for

exposure periods of up to 48 hours. A wire gauze cage containing 50 examples of *C. granaria* was in each case placed at the bottom of the bin and four others were distributed vertically through the wheat at intervals of rather more than 4 ins. The fumigants were applied in a petri dish placed on the surface of the grain. At a dosage of 60 mg. per litre, both gave complete mortality throughout the bin after an exposure of 24 hours, and neither could be detected after ventilation for 48 hours. Exposure to 48 mg. for 24 or 48 hours was less effective.

In laboratory experiments on the effect of treatment with trichloracetonitrile on the germination of wheat, exposure to concentration of about 60 mg. per litre at 20°C. for 24 hours slightly delayed germination, and exposure to about 45 mg. for 48 hours reduced viability from about 80 to 60 per cent. The vitamin B content of wheat fumigated at a concentration of 72 mg. per litre for 48 hours at 20°C. was not impaired. Trichloracetonitrile was successfully used to control *Oryzaephilus surinamensis*, L., in dried currants, and it was as effective for this purpose as ethylene oxide. Both gave 100 per cent. kill with an hour's exposure to 48 mg. per litre, as did trichloracetonitrile with two hours' exposure to 60 gm. The toxicity of trichloracetonitrile was increased by the addition of 10 per cent. or more (by volume) of carbon dioxide, but in practice the complication of adding this amount may outweigh its advantages. It was highly injurious to growing plants.

The fumigant was also successfully used against bed-bugs (*Cimex lectularius*, L.) and house-flies (*Musca domestica*, L.) [*cf. R.A.E.*, B **33** 149]. In tests against the latter, the product of the concentration and the period of exposure required for complete mortality in the laboratory had only to be doubled to give complete mortality in a room, which confirmed indications obtained during the fumigation of wheat in bins that this material is absorbed only to a very slight extent.

MOHAMMAD AFZAL, DWARKA NATH NANDA & MANZOOR ABBAS. **Studies on the Cotton Jassid (*Empoasca devastans* Distant) in the Punjab. IV. A Note on the statistical study of Jassid Population.**—*Indian J. agric. Sci.* **13** pt. 6 pp. 634–638, 3 refs. Delhi, 1944.

In studies on the relative resistance of different varieties of cotton to *Empoasca devastans*, Dist., in the Punjab, the populations of the Jassid were estimated by sweeping the adults, by counting living nymphs on the leaves, or by counting dead nymphs and adults on and under the plants after each had been enclosed in a fumigation chamber and fumigated with calcium cyanide, and the data were subjected to statistical analysis. It was found that the logarithmic transformation employed by C. B. Williams [*R.A.E.*, A **25** 656] gave a much more precise measure of significance than the original data. The order of susceptibility of all the varieties of cotton tested remained practically the same whichever method of estimating populations was used, and sweeping, which is the cheapest and simplest, is therefore recommended. The relative resistance of the varieties tested is briefly discussed.

PAPERS NOTICED BY TITLE ONLY.

SEMANS (F. M.). **Protozoan Parasites of the Orthoptera, with special Reference to those of Ohio. IV. Classified List of the Protozoan Parasites of the Orthoptera of the World. Classes Mastigophora, Sarcodina, and Sporozoa.**—*Ohio J. Sci.* **43** nos. 5–6 pp. 221–234, 271–276, 4 pp. refs. Columbus, Ohio, 1943. [Recd. 1945.] [*Cf. R.A.E.*, A **30** 416.]

VAN EMDEN (F. I.). **Larvae of British Beetles. V. Elateridae** [including keys to genera and species].—*Ent. mon. Mag.* **81** pp. 13–37, 54 figs., refs. London, 1945. [*Cf. R.A.E.*, A **32** 72.]

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